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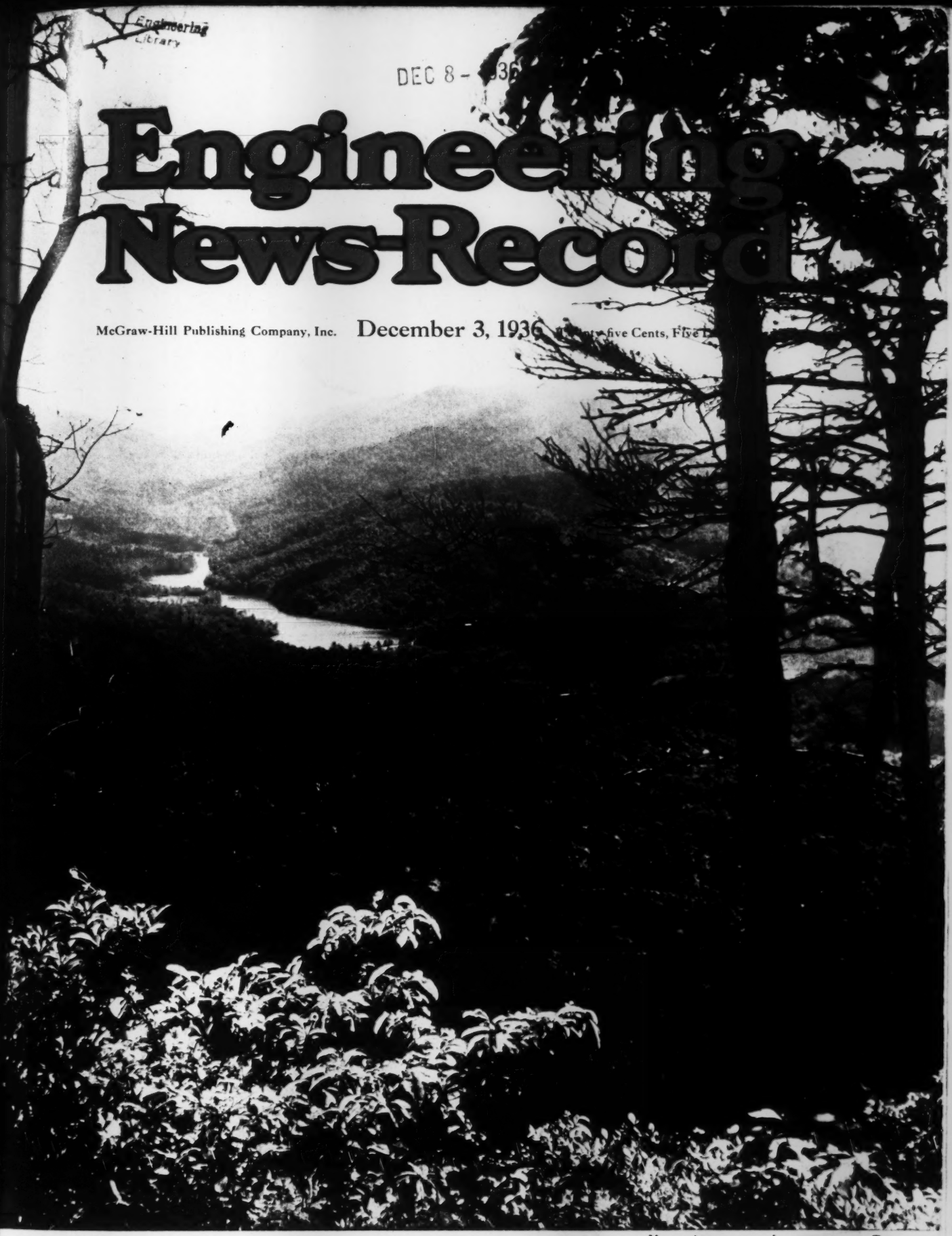

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THE TVA

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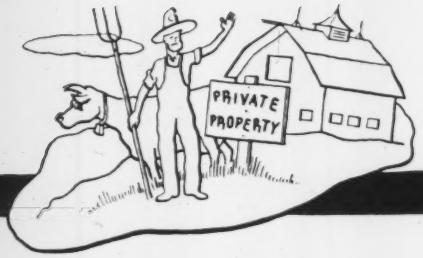

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A MOMENT WITH THE PUBLISHERS

The Search for STABILITY

IN the November *Atlantic* Walter Lippmann presents, under the title "The Government of Posterity," another article in his series that began in the September issue of that journal.

Here he is dissecting the collectivist concept of centralized social and economic control under modern conditions. He shows how the complex processes of present-day business and society tend to curtail mobility and to require greater flexibility in management. This, in turn, implies a wider scope for personal initiative rather than the narrower and more rigid regulation of highly centralized control. And in this connection he says something that deserves to be pondered by those who seek consistently to "stabilize" their own situation in order to improve their relative status in the economic scheme.

MR. LIPPMANN says, "This principle of diminishing mobility with the increase of scale and complexity may be observed in all human organization. Mr. Henry Ford, for example, cannot change the design of his cheap cars which are turned out in mass as he can change the design of a car made largely by hand; the new tools needed to vary the design are too complicated and too expensive. But Mr. Ford can change the design more readily than can a manufacturer who is immobilized by a great capital structure and a heavy load of debt. So, as industrial organization becomes bigger, it must become more inflexible until in its last stages it is hostile to invention, enterprise, competition, and change. It is unable to consider any ideal except stability.

"This narrowing of objectives with increasing complexity is the phenomenon of bureaucracy. It is to be found in governments and in corporate business, in armies and in churches and in universities. The more intricate the organization, the more it must renounce its ambitions in order to perpetuate itself.

"Thus it is no coincidence that the watchword of policy in recent times should have been 'stabilization'—of output, hours of work, processes, markets, wages, prices, and the quality of goods. Though it is commonly believed that it was necessary to organize for stability against the 'chaos' of competition, the truth is that it has seemed necessary to stabilize because organization has become so elaborate. As modern nations adopted protection, assented to large-scale industrial organization, with heavy fixed capital charges and large overhead costs, with wages and hours established by law or contract, with rates and prices established by government commissions or by monopolistic agreements, the unorganized and unprotected interests, such as agriculture and marginal labor, had either to bear the whole burden of adjustment or to organize in self-protection.

"In such a line of evolution the economic objective can no longer be increased wealth through new inventions, new enterprises, and successful competition. The objective must become stabilization at the existing level of productivity, variety, and economic technic.

"Thus it is that many have been persuaded that the importance of cheaper goods is a menace, that technological progress is a disaster, that to produce more is to earn less. They have the conviction that if only they could close the ports of entry, if only they could erect round their occupation a sufficiently high Chinese wall composed of holding companies, mergers, marketing contracts, production agreements, licenses, quotas, labor laws and labor contracts, a wall high enough to exclude new ideas, new methods, new men, and unusual labor, they would enjoy the blessings of stability. They are quite right. A society which has organized itself elaborately must keep on until it has organized itself into rigidity. It must seek stability because it cannot advance. It must imitate the mollusk, which, though it can neither walk, swim, nor fly, and has only meagre ambitions, does seem to enjoy a reasonably well protected and stable existence."

WITH the revival of business, the clamor for measures to "stabilize" industry, had become less urgent, but today new moves in that direction appear to be in the making. So, as we debate these moves and measures to achieve stability, it will do no harm for us to weigh the price we must pay to attain it.

Willard Chevalier

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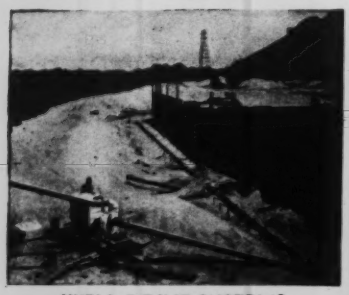

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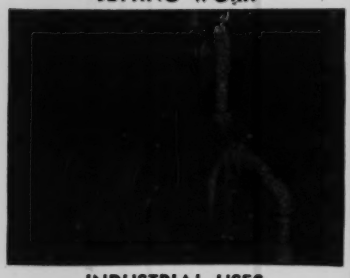

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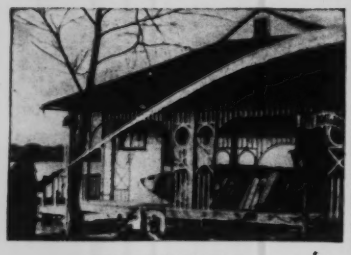

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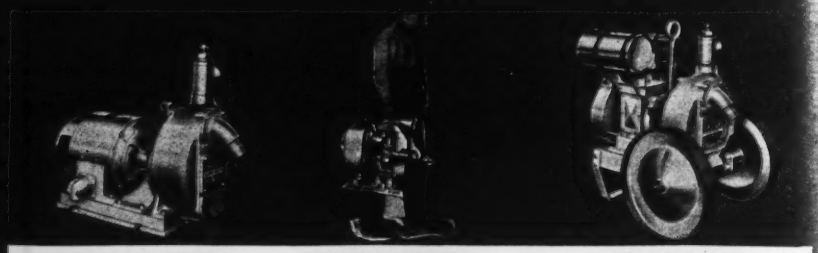

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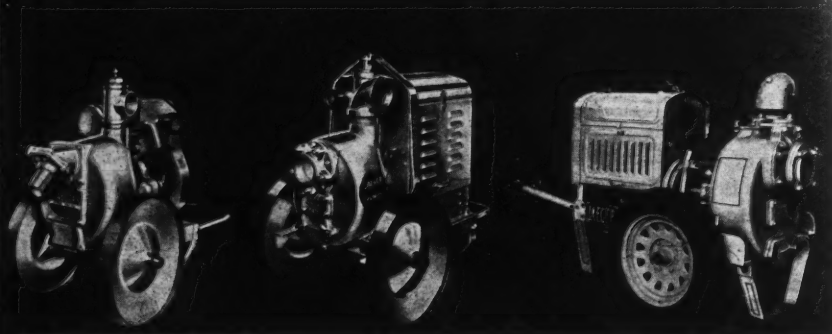

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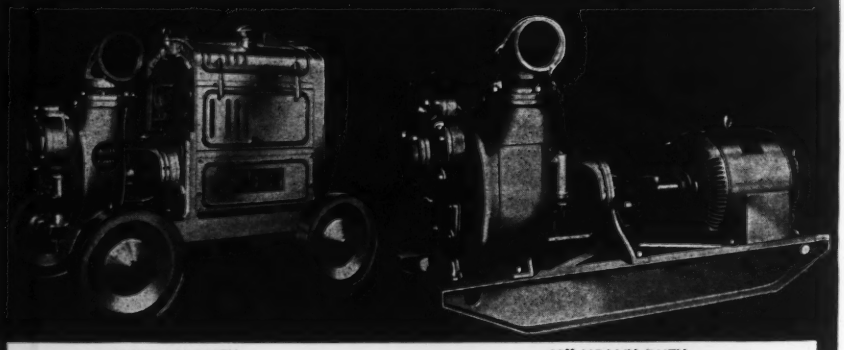

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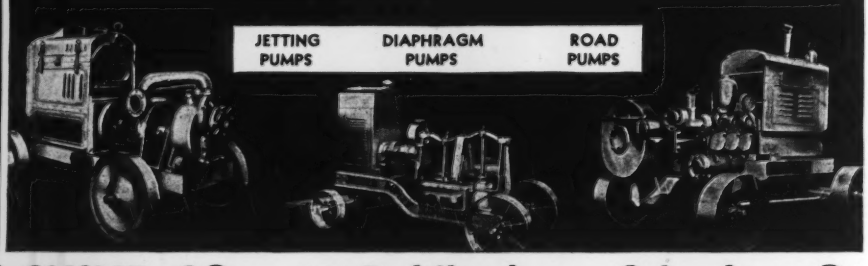

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■

How High is a Dam?— This old and still unanswered question is to be raised in the issue of December 10, not to provide an opportunity for the editors to express their views but in the hope of stimulating the profession to answer the question by official action.

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ENGINEERING NEWS-RECORD

December 3, 1936

The Tennessee River Experiment

First of five articles on the Tennessee Valley Authority, whose creation in 1933 initiated the first attempt ever made to control and utilize a large river for the benefit of the surrounding region.

Mountain forests at the Tennessee's source

BORN OF A CONFUSION of diverging motives during the swiftly moving days of 1933, when under urge of a crisis governmental policies were going through kaleidoscopic changes, the first attempt to make the full resources of a large river useful to man has been in progress in the Tennessee Valley for the past three years. This attempt, carried on by the Tennessee Valley Authority, came into being as one phase of what has been hotly debated as a governmental power-yardstick undertaking. It is setting a new milestone in national development activities.

Comprehensive river development has never been tried; recognized in theory only, it is a new thing in practical experience. Prior work to curb or utilize a river had aimed at only a single purpose, such as improved navigation, or control of floods, or power generation, or storage for supply of water to cities or farmlands; in many cases such one-purpose work had done injury to other purposes. In a few rare instances, prominent among them Boulder Dam, a project had been planned to serve more than one purpose, but in every case of the kind it was a localized project. Control and beneficial development of the full length of a river for the service of the region along its entire course had never been conceived, much less carried out.

Thus the Tennessee Valley Authority, the government corporation formed to carry out the Tennessee Valley Act, was faced with a task of new kind. It had to create the methods by which to handle this task, in both engineering and administrative procedure. One of these difficulties lay in the fact that, operating in the domain of half a dozen state governments and many hundreds of county and city governments, it had to enlist the active support and cooper-

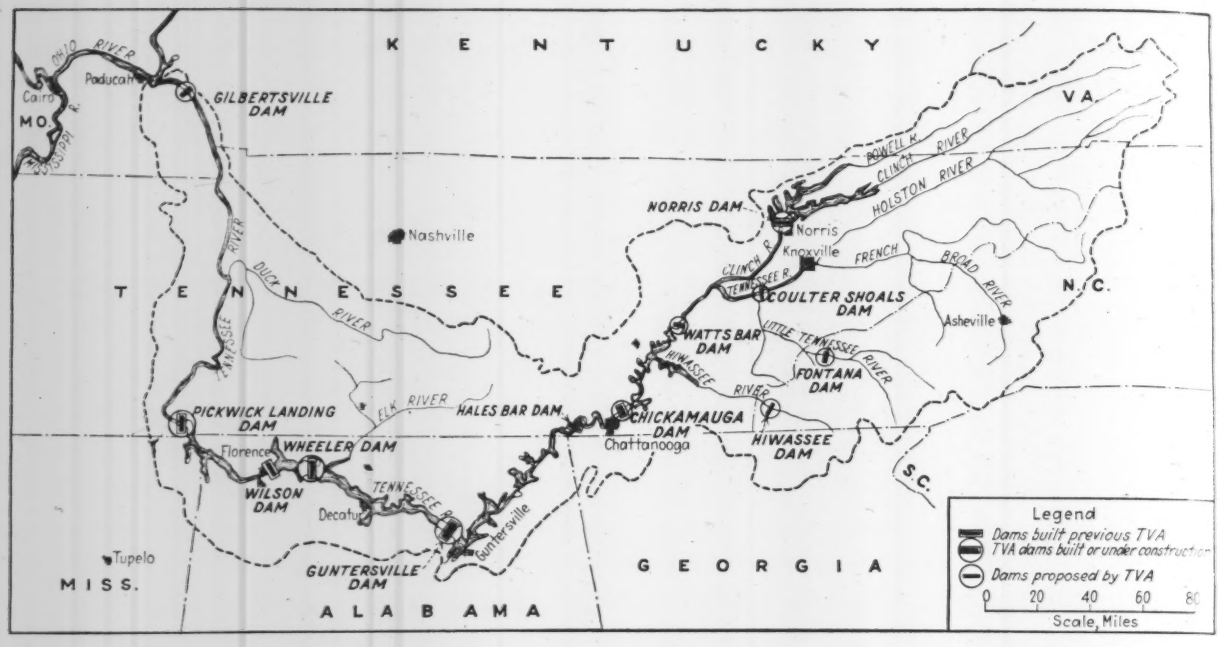


FIG. 2—CARRYING WATER from the regions of high rainfall in the Appalachian Mountains by a circuitous route to the sea, the course of the Tennessee River gives rise to many problems of stream regulation, flood control and power production that have intimate bearing on the economic wellbeing of the land which it traverses. The Tennessee Valley Authority is trying to work out these problems in the best interests of the valley region.

ation of all these authorities, an all but impossible task; there is no formula for such cooperation.

In these circumstances the record of what the Tennessee Valley Authority tried and what it has accomplished to date in its river work is fundamentally important as a demonstration of the difficulties and problems of such undertakings, and their solutions so far as yet worked out. The present article and those which will follow have, therefore, been prepared from observation of the TVA's activities since its early months and from official data, with a view to setting forth the evolution of this pioneer experiment.

A pioneer experiment

It is unnecessary here to discuss the purposes of the Tennessee Valley Act, as these have been interpreted variously and often temperamentally.

Some considered it a power-yardstick measure, others a measure primarily intended to salvage the huge and until now almost wholly wasted Muscle Shoals investment; others again looked upon it as a regional reconstruction measure, designed to bring about the economic improvement of a large integrated area. But the simple fact is that, whatever else the measure does, it authorizes and directs complete development of the Tennessee River. And this, as just stated, is a revolutionary innovation.

Since that time the sheer pressure of need has made the subject of comprehensive river planning and development a matter of profound public concern in many other stream valleys. In many basins the future of land, people and industry has been seen to be so closely tied up with the waters and the floods of the river as to make an integrated development plan of river and region the key to progress. In fact, because of this new understanding of river problems it now appears likely that much of our future river-improvement work will be guided by all-purpose and full-length stream planning—some of it in connection with the study of land-use, of mineral resources, of agriculture, of transportation and related factors.

Such undertakings of course, involve many engineering questions that are new and highly complex. In addition there are new and serious problems of personal and governmental relations, for such activities as flood control and silt prevention extend into the domain of local governments and require the active cooperation of state, city and county authorities in the drainage area.

The assigned job

The work that Congress assigned to the new government corporation, the Tennessee Valley Authority, was anything but simple in itself; it was rendered still less simple by the confusion of conditions that lay back of the passage of the act.

For 15 years the ill-starred Muscle Shoals power plant and nitrate factory had come before each new Congress as an irritating, hopeless problem. Successive proposals to salvage some use value—to sell the plant to a power company or to a manufacturing industry, or to operate it in the public service—had been discussed interminably, and had all been rejected. Meantime the army engineers at the direction of Congress had made a new study of Tennessee River navigation development, with some headwater storage as part of the project to increase low-water flow. Meantime also the demand for navigation facilities in the river better than the existing 1- to 4-ft. draft was increasing and had already (1930) led Congress to authorize a 9-ft. navigation project—of which, however, only one lock had been started.

It seemed clear that a large improvement expenditure would soon be necessary. Recurring flood troubles along the river gave this prospect added force. From a wholly different approach, a plan of developing several government power plants to serve as yardsticks of power utility service was put forward by President Roosevelt, and the wartime Wilson Dam plant at Muscle Shoals, together with associated power developments on the Tennessee, fitted naturally into this plan. The power-yardstick and river-improvement purposes received powerful impetus from the intense pressure of unemployment and the logical necessity of utilizing public works to provide reemployment to break the depression.

Out of this mass of diverse conditions and motives, the Tennessee Valley Act made one single problem of river development, creation of a modern navigation system, control of floods, operation of the old Wilson Dam plant, preservation of a wartime munitions supply source that would be used for

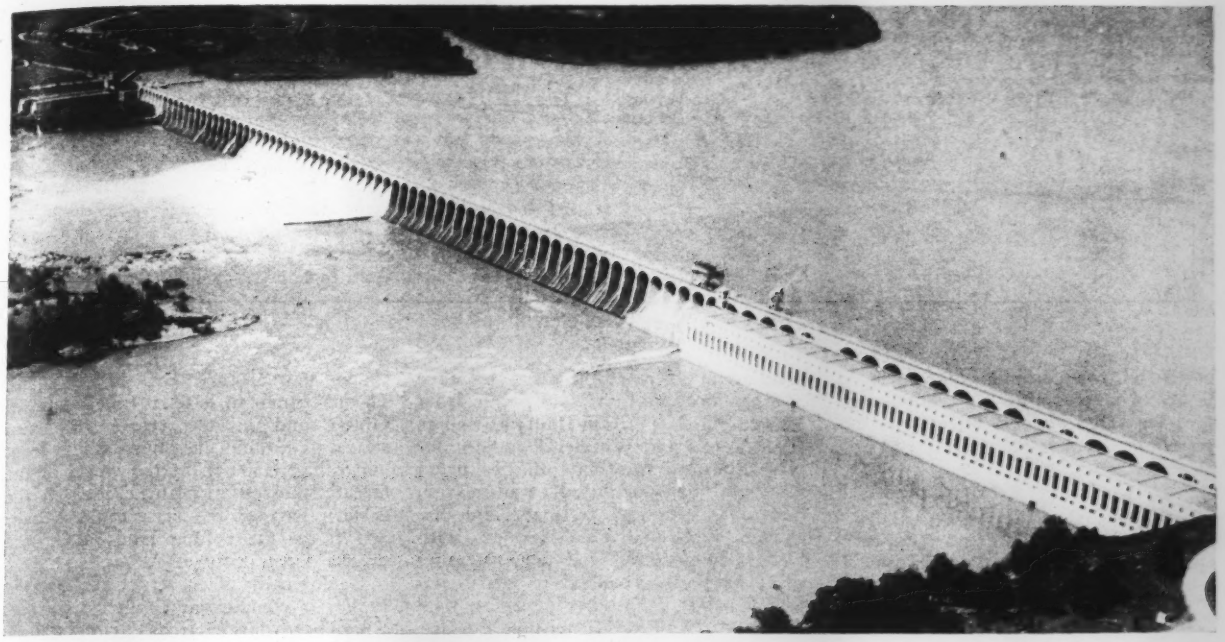


FIG. 3—A WARTIME RELIC, Wilson Dam, at Muscle Shoals, was one of the prime motives for starting the Tennessee Valley development experiment. Wilson Dam has been of little value to navigation, as water depths below the shoals are as low as 4 ft. in the dry season, too shallow for freight transportation.

fertilizer production in normal times, and development of power at the necessary river dams. It assigned this huge problem to a government corporation formed for the purpose, with a view to giving the work a business rather than a governmental character. The unemployment emergency caused the measure to go through Congress promptly, so that it was enacted early in the summer of 1933 as the first item of the later-authorized vast program of emergency public works. The directors of the corporation were promptly appointed, and the undertaking was set in motion.

A river-development mandate

The breadth of purpose contemplated in the original enactment is clearly indicated by its preamble statement, which declared the Act to be for

maintaining and operating the property now owned by the United States in the vicinity of Muscle Shoals, Ala., in the interests of the national defense and for agricultural and industrial development, and to improve navigation in the Tennessee River and to control the destructive floodwaters in the Tennessee River and Mississippi River Basin.

Specifically, the act empowered the Tennessee Valley Authority to build dams that would provide a 9-ft. channel in the river and maintain the necessary water supply for navigation, these dams also to control destructive flood waters in the Tennessee and Mississippi. The Authority further was directed to produce fertilizer at Muscle Shoals, and was given the right to acquire or build powerhouses and transmission lines as well as "navigation projects and incidental works," in the Tennessee River and its tributaries. Finally, it was empowered to pass on any dams or other works that might be projected by other interests on the river system.

FIG. 4—HALES BAR POWER DAM in the picturesque gorge region below Chattanooga was the only development on the main Tennessee River before the government built Wilson Dam. Extensive cavern formations in the limestone under this dam, and repeated attempts to close off the flow of water through these subterranean channels, wrote some noteworthy chapters in dam construction history a quarter century ago.

Emphasizing the commanding position of streamflow control in the whole scheme, the act directed the Authority to operate its structures "primarily for the purposes of promoting navigation and controlling floods." But it also permitted the Authority to provide and operate power generation facilities "in order to avoid the waste of water power," and to transmit and market such power.

These manifold instructions and authorizations clearly reflect the intent to accomplish comprehensive development and utilization of the river's resources. While some of the language

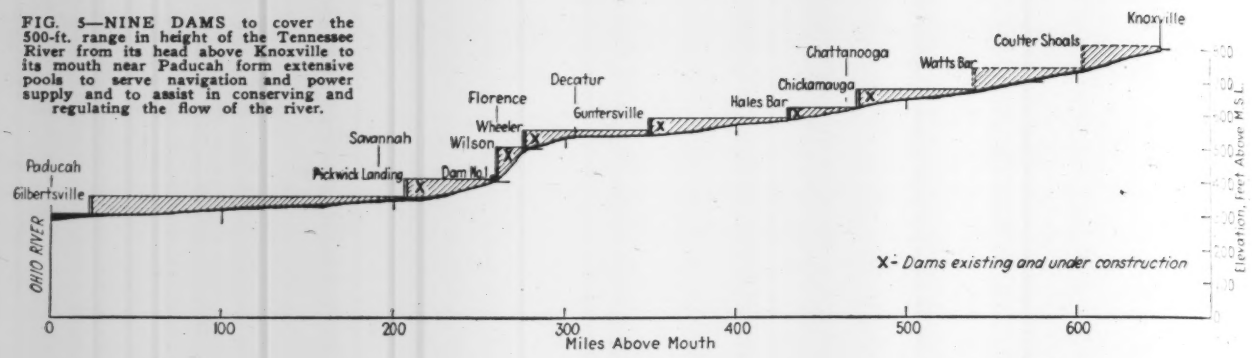


FIG. 5—NINE DAMS to cover the 500-ft. range in height of the Tennessee River from its head above Knoxville to its mouth near Paducah form extensive pools to serve navigation and power supply and to assist in conserving and regulating the flow of the river.

quoted is from amendments made to the act two years after its original passage, the same general intent was expressed in the original act.

To work out a broad plan

One further duty of great magnitude, representing a separate and difficult assignment, was laid on the Authority. A paragraph directed the making of surveys and general plans for the Tennessee Basin and adjoining territory in respect to public improvements that would foster "an orderly and proper physical, economic, and social development of said areas," with a view to aiding "the proper use, conservation and development of the natural resources" of the region (so far as they are related to the development consequent to the act), "for the general welfare of the citizens of said area." In other words, the Tennessee Valley Authority was required to study the general economic improvement of the river basin. Its task was not limited to the river channel itself, but in respect to study, at least, was given remarkably broad scope. The problem of regional development was united to that of river development.

The breadth of the work entrusted to the Authority might suggest that the corporation was to take on almost a governmental character in the magnitude of its operations and their impact on the wellbeing of several millions of people. In fact the Tennessee Valley Authority has sometimes been spoken of as a supergovernment. However, it has at no time acted otherwise than would any other corporation or administrative agency; it has done no supergoverning, in fact no governing except such as any construction company or agency does in operating the camps and villages of its construction projects.

Work accomplished

To state in briefest form what the TVA has done or attempted:

It has designed and built dams and powerhouses; has made rainfall and riverflow studies; has surveyed land and waters; has studied soil erosion and forest conditions and has operated forest nurseries; has assisted the people residing in its reservoir areas to move to other locations; has sold power from Muscle Shoals (Wilson Dam) as well as from Norris and Wheeler Dams to municipalities and to private utilities, using its own or purchased transmission lines; has produced fertilizer and distributed it to individual farmers with a view to fostering and demonstrating soil-conserving methods; and has joined hands with other agencies, such as the Agricultural Extension Service, the Soil Conservation Service, the Forest Service and the National Park Service, in furthering work that concerned both parties. It has spent $100,000,000 on these varied activities.

In the progress of this work during a period of 3½ years, the essential function of the TVA as an agency to carry out comprehensive development of the Tennessee along its whole course for all uses has evolved more and more clearly. Many engineering and administrative problems have been worked out; many others remain to be solved.

Conditions of the problems

In detail the course of the experiment was largely shaped by the rather unusual conditions of the region involved. The basin contains a large amount of steep country, with high rainfall and a soil that is easily washed away when unprotected, and extensive parts of the area have never yielded more than a precarious livelihood to the occupants. Its industrial development is quite limited. Its location with respect to transportation lines has long imposed handicaps on its ability to compete in the general markets. Its agriculture is in part good, in part mediocre, and in larger part poor. Thus, before the details of the experiment are taken up it will be necessary to consider briefly the physical facts of the river and the region.

The Tennessee River flows for a length of 650 miles in a great fish-hook course from where it is formed by the junction of the Holston and French Broad rivers, just above Knoxville, in northeastern Tennessee, to the point where it discharges into the Ohio River, near Paducah, Ky.; adding the length of its headwaters, the system's total length is nearly 1,000 miles. Its drainage basin, of the same fishhook shape, has an area of 40,600 sq.mi. (about equal in size to the state of Ohio) and includes parts of seven states. The land elevations range from more than 6,500 ft. at the crests of the Great Smokies and Blue Ridge in the eastern part of the area to little over 300 ft. in the rolling lands along the river's lower course.

Geologically the structure of the region is complex and much disturbed. There are large areas of crystalline rocks in the headwaters, but the characteristic rock of the basin is limestone, of relatively high solubility. In the plateau regions of Tennessee and northern Alabama coal beds occur. Other mineral resources include iron ore, salt and gypsum, phosphate, kaolin, mica, feldspar, bauxite and ocher.

Forest of some kind covers something more than half the basin's 26,000,000 acres. The soil, fine-textured, absorbs water slowly, has rapid runoff, and erodes freely unless protected by adequate ground cover. Soil erosion and gullying is startlingly common on the cleared and farmed lands.

Rainfall and runoff

The mean annual rainfall in the basin is about 52 in.; individual years may vary from 40 in. to 60 in. Some parts of the eastern mountain areas have exceedingly high rainfall, with means reaching 80 in. Gulf storms entering from the west and West India hurricanes coming north from the coast cause intense precipitation at times. Runoff averages 24 in., or something less than half the rainfall. Yet the large underground flows contribute much to streamflow. Of the total Clinch River runoff at Norris Dam about half comes from springs in the limestone.

The population numbers 2,500,000, about one-fourth of which is in cities. Industries include mines, textile and paper mills, chemical and aluminum plants, and in the mountains a good deal of small handicraft.

As reflected in the large proportion of forest area and the relatively small population, as well as in the amount of soil erosion, the potential wealth of the region has not been developed as highly as in more favored farming or industrial states. Agricultural yields

are moderate; much of the agriculture is virtually of subsistence-farming type, and there are large areas of tenant farming. Mineral-resource industries are limited, and to some extent have been declining, as in the case of the large deposits of phosphate for fertilizer found in Tennessee. Transportation disadvantages contribute to limiting the economic development of the valley. Railroad growth is hampered by mountain ridges and plateaus, river transportation by shallow water, and the railroad rate structure puts the region at a disadvantage.

A century of effort

In view of the conditions just sketched, it is important to note that Tennessee River navigation possibilities have had attention for more than a century. As early as 1824 John C. Calhoun, Secretary of War, recommended to President Monroe that the river be improved. Some work has been done throughout the intervening century; from 1852 to 1932 Congress authorized no less than 19 projects from Knoxville down. But all the work, being done in small bits, left the waterway inadequate and failed to create any substantial commerce. Local sand and gravel transportation has been the main freight traffic in recent years.

The minimum depth of water in the Tennessee below Sheffield, Ala., is only 4 ft.; from the Wilson Dam pool just above Sheffield to Chattanooga only 3 ft.; from Chattanooga upstream to Knoxville only 1 ft. Such conditions are manifestly unfavorable to water transportation. The Tennessee Valley Act recognized that an adequate channel must be provided if navigation is to become real. The Authority's first task therefore was to plan for adequate navigation depth and facilities.

Effective river improvement must necessarily consider control of floods, as the topography and rainfall characteristics of the valley favor large floods. Rugged hills, high rainfall and steep stream slopes in the eastern mountain areas, combined with impervious soil, tend to produce rapid concentration of runoff. Chattanooga, located in the geographical center of the valley, experienced large floods in 1867, 1875, 1886 and 1917, and floods of more local character have done serious damage at other points, as at Asheville, N. C., in 1916, and at Harriman, Tenn., in 1929.

Because the largest main-river floods occurred half a century or more ago, the possibility of very high floods has had little thought. Studies of the TVA indicate that Chattanooga may at any moment experience a flood much greater than that of 1867, whose discharge (for a drainage area of something over 20,000 sq.mi.) is believed to have been about 460,000 sec.-ft. Such a volume would submerge most of the present city; yet forecasts indicate that a flood of 700,000 sec.-ft. may occur.

Further, the Tennessee, as largest tributary of the Ohio, has an important effect on the great floods of the Mississippi. In January, 1913, the Tennessee contributed more than 240,000 sec.-ft. (18 per cent) to the Mississippi's crest stage; in the record flood of March 1927 it contributed even more—297,000 sec.-ft., or just one-fifth of the Mississippi's entire flow. If a substantial part of the Tennessee's floods can be held back, the Mississippi's flood crests would be definitely reduced.

Power enters the picture

It will be remembered that as a war-time project the government 18 years ago built a great power dam across the Tennessee at Muscle Shoal, together with two costly nitrate factories. The power plant has had little use since then, the nitrate works none. The Tennessee Valley Act therefore turned Wilson Dam over to the TVA and authorized this agency to sell the power generated there and at its other dams, as well as to create an interconnected power system and to control the resale rate of the power it sold.

These provisions, together with the mandate that the TVA should produce fertilizer for agricultural use, naturally turned some of the earliest efforts of the Authority toward the power problem. Opposition to the power program on the part of utility corporations, followed by acrimonious litigation, marked this part of the work and caused some delay in the development of the power side of the TVA's work.

FIG. 6—A SMALL AMOUNT of navigation in the shallow reaches below Knoxville gives a suggestion of possible river traffic to be developed for the commercial upbuilding of the Tennessee Valley through improvement of the river.

FIG. 7—IN JANUARY, 1936, the storage of water behind Norris Dam, on the Clinch River 20 miles above Knoxville, brought the TVA's first specific assignment of duty by Congress to completion. Norris reservoir helps to control floods, and increases the river's low-water flow.

From the viewpoint of river development the important effect of the power clauses of the law was to cause the Authority to study its dam and reservoir plans with consideration for efficient power production as well as navigation and flood control. Thus the twofold problem of water control and management was complicated by a third factor.

To aid navigation, conserve water and control floods in such a river as the Tennessee, dams must be built, and dams mean power. At Wilson Dam, for example, "the power of falling water was an inevitable incident of the construction of the dam," as the United States Supreme Court said in deciding a suit brought against the Authority to prevent the sale of Wilson Dam power. (*Ashwander vs. Tennessee Valley Authority*, decided May 1935). Hence coordinated river development undertaking was bound to include power production. Whether a market could be found for this power was hotly discussed, but reasonable opinion (supported by large increases in power consumption per customer during the last two years) holds that the growth of the region and increasing intensity of power use will develop an adequate new market for the river's power.

Conflict of water uses

Even this brief indication of Tennessee River problems is sufficient to emphasize the desirability of seeking for comprehensive development and control of the river, in order to deal with all the problems in balanced manner. But it is known that efficient use of a river's waters for several purposes at once is not easily realized. Flood storage and water conservation storage tend to be antagonistic; a reservoir to conserve water must be kept as full as possible, one to receive floods as empty as possible. Likewise management of reservoir storage to serve navigation is apt to be at odds with management for power production. Accordingly planning for comprehensive use will involve some compromises to obtain the best adjustment of the several objectives. In the work of the TVA it was early found necessary to weigh the several uses and their value to the region in deciding upon the desirability of any project or individual structure.

One unexpected conflict developed in the construction of reservoirs, namely the formation of mosquito breeding grounds by the impounding of water in the reservoirs. Malaria is endemic in parts of the river valley, and control of malaria mosquitoes is therefore urgent. Even in the Norris Dam region, where malaria has been practically unknown, it was found that the malaria mosquitoes quickly utilized any breeding places offered by pools. Intensive study had to be given to both construction and operation in order to control the mosquito menace.

Another important conflict occurred in connection with the building of dams in the river valleys; they flooded good agricultural lands, the most productive in the whole basin, and it became necessary to replace the production capacity so removed by relocating the farmers who previously lived on the lands. The pool behind Wheeler Dam, extending 74 miles up the Tennessee and 30 miles up the Elk River, submerged 50,000 acres of cotton farms, and a related condition as to other kinds of crops existed at Norris. In addition, the reservoirs also conflicted with highways, railroads, towns, cemeteries and industries to a degree that made some desirable reservoirs not feasible and in all cases affected the cost and complicated the planning and construction.

Considering the engineering problems alone, study showed that conflicts of use could in most cases be harmonized with little loss of efficiency. At Norris Dam, for instance, the lower part of the storage could be reserved for water equalization and power while the upper part of the reservoir was devoted to flood storage. At the main river dams it was possible to work out schedules for operating the reservoirs in accordance with a system of flood prediction in such a way as to make maximum storage available for flood reduction.

Basic Studies

Under the circumstances of the case and the terms of the act it became necessary to go ahead with construction of parts of the plan while carrying forward planning of the entire program. Immediate construction of Norris Dam was specified in the original act. Construction of Wheeler Dam was ordered by the President in the fall of 1933 as the result of local demands for a work-relief project in that part of the valley; the army engineers were just

completing the lock at that site, and the dam could be started quickly. Probably it did not fit into an ideal development plan as closely as would a dam at Pickwick Landing, but there was no compelling reason why it should not be built. Hence the planning for river development was modified accordingly.

However, the principles of unified planning were promptly put into action. For purely navigation purposes the Wheeler lock with headwater at El. 541.0 was considered best by the army engineers, but when considering the factors of flood control and power a headwater level at El. 555 was needed, thereby saving the cost of building an intermediate navigation dam between Wheeler and Guntersville. The TVA arranged with the army engineers to raise the lock and extend the construction contract accordingly, to permit of building Wheeler Dam higher.

Subsequently, construction of Pickwick Dam was begun voluntarily by the TVA as the most logical step. At a more recent date the TVA has again been forced to yield to outside pressure to start Chickamauga Dam, though it would have given Guntersville priority. At present the latter also is under way.

Hydraulic studies for conservation and utilization of water resources of the basin were vigorously prosecuted, to show what would be the best for the entire region and would achieve the optimum in water conservation and utilization. Because of the large area of the Tennessee Valley and the number of projects in the complete plan, this problem has been exceedingly intricate. A series of high main-river dams was early found preferable to the numerous low dams previously contemplated; Norris Dam was built to greater height than the army engineers had recommended, so as to perform better equalization service; headwater storage on other tributaries was found essential; the various reservoirs were carefully proportioned for best co-operation.

From the very start of the work, the chairman of TVA, Arthur E. Morgan, recognized that adequate engineering data are vital. Since no satisfactory maps of the region were available, a co-operative program was entered into with the U. S. Geological Survey to provide planimetric and topographic maps for locating dam and reservoir sites, for estimating the lands and improvements that would be flooded, for planning highway and railroad relocations, for general land-use studies, for regional planning and other purposes. The Geological Survey has also co-operated extensively in rainfall and stream gaging. Soil maps are being prepared in co-operation with the U. S. Bureau of Chemistry and Soils, to be used in classifying lands preliminary to a program of erosion prevention that has been undertaken co-operatively with the Department of Agriculture and the Forest Service.

Careful investigations have been made of flood history on all the streams. To supplement the existing meteorological stations of the U. S. Weather Bureau, additional rainfall and evaporation stations were established. A comprehensive program of streamflow measurements is being carried out. Silt investigations are being made. All of these and related records are necessary to the safe and economical planning of dams, forecasting floods and river stages during and after construction, operating a unified system of river control, and advising states, cities, and industries on problems of flood control, stream pollution and water supply. Further borings and geological investigations have been made to determine the most feasible dam sites, as well as to learn whether valuable mineral deposits might be submerged in a proposed reservoir.

Land and industrial studies

On this factual basis the development of a coordinated plan has proceeded, including both the works to be constructed at present and those that may be undertaken in the future. The value of unified development became increasingly apparent in the course of the studies. Development of even the finest dam sites as isolated undertakings might have prevented the best development of a unified system of dams. An individual or a corporation utilizing a choice site for a relatively small dam might block an economic and effective general development. It might be found, too, that a small site which stands out conspicuously in a local survey would be entirely submerged in the backwater of a really important site.

Along with the water-control planning there has been carried out corollary planning for related activities. One of these is forestry. In this phase of the program two major objectives are sought: first, the maintenance and improvement of existing woodlands to provide an efficient supplementary water and soil control system, and second, restoration of areas of open land now seriously eroding, in order to forestall rapid silting-up of the reservoirs.

Agricultural planning is tied in closely to the water-control program. The TVA directors held that water conservation presumes the adoption of watershed protection measures through readjustment of land use on the watershed. Moreover, the act specifically authorized maintenance of laboratories for discovery of new forms of plant food and conduct of experiments for testing their effectiveness. To this end the fertilizer plant at Muscle Shoals was modernized and studies were carried on to determine the efficiency of various fertilizer productive processes. Finally, an extensive demonstration program was initiated to measure the value, effect and economic use of the products of the experimental plants, in co-operation with the state agricultural colleges and the U. S. Department of Agriculture.

Industrial improvement studies are represented principally in research and

FIG. 8—FOR MANY GENERATIONS farmers have cultivated steep hillsides in the Tennessee Valley, which practice together with the fine-textured character of the soil has caused extensive erosion and gullying. Production of fertilizer by the TVA and use of the fertilizer on demonstration farms is intended to lead the way to a cure of this destructive process.

demonstration projects to show the possibilities of the resources of the region. A ceramics laboratory is maintained at Norris. Experiments are also being conducted on various minerals found in the basin as to their suitability for various purposes, such as that of ochers for paint making.

Land-use studies form another phase of TVA operations. Recreational possibilities of the region have been investigated. The highland portion of the valley offers unusual opportunities for recreation. In many sections good farm lands are scarce, timber is nearly exhausted and minerals are not marketable, but climate and scenic beauty combine to form recreational resources that have a potential dollars-and-cents value to the inhabitants.

Complicating factors and obstacles

To do a job as big and difficult as complete control of the Tennessee River *plus* study of all its regional involvements would be a gigantic task under even the most favorable conditions. The TVA has had to wrestle with serious complicating factors.

Bitter opposition by the private utilities has already been referred to; but this developed in the main only after the TVA had been at work for some time. An earlier difficulty, and the biggest of all, was divergence of purpose at Washington. Some of the people who had promoted the act wanted a public power system and cared for nothing else; others had less radical aims and sought for complete river development. The split in objective could not fail to produce friction that wasted valuable momentum.

Internal discord also caused difficulties. There was divergence of purposes within the Authority. Its makeup, intended to provide for the varied elements of the work to be done, included an engineer of long experience in river and flood matters (Arthur E. Morgan), an agricultural leader (Harcourt A. Morgan, no relative), and a utility commissioner experienced in the relation of power to public use (David E. Lilienthal). Each of the three tended to see his part of the work as primary. The broad problems of river development therefore could not always count on harmonious attention, a situation that involved some real dangers of large magnitude, especially in deciding whether the hydraulic system of reservoirs should be operated in obedience to power demands or flood-control and navigation needs.

A different complication was the fact that the Tennessee Valley was not interested in the TVA. It cared only about seeing millions of dollars spent locally. The towns and the politicians wanted pork. Visions of a revived land-boom craze gripped the Muscle Shoals real-estate desert, which years earlier had lured thousands of lot-buying suckers from far and near and emptied their purses. The business circles of Chattanooga, metropolis of the valley, knew little and cared nothing about the TVA even after six months of real work. The TVA board, busy with construction, failed to take time to "sell" its work to the valley, and so local cooperation was slow to develop.

State, city and county authorities, the real governing units that might have been expected to urge their cooperation on the TVA, did nothing of the kind. They haven't to this day.

Again, the valley's interests are not a unit. The cotton-farm owners and tenants in the bottom lands have nothing in common with the woodsmen and subsistence farmers of the Cumberland Plateau or with the upland dairy farmers. Western North Carolina and northern Alabama differ from each other as much as Maine and Mississippi. It is not easy to plan for furtherance of the economic and social conditions of such a heterogeneous region, or to enlist the cooperation of the several groups.

Finally, there was a huge organization problem. Technical and administrative staffs for work of extreme novelty and complexity had to be assembled, the jobseekers had to be fought off, adequate data had to be gathered, earlier plans had to be reviewed and revised in the light of the new data, before any far-reaching plan could be approved or construction layouts developed. Yet construction work had to be started quickly, to meet the unemployment emergency.

Such major hurdles, plus a proportionate number of minor ones, slowed up progress of the TVA experiment. That so much has nevertheless been accomplished in little over three years is noteworthy evidence of what strong, constructive effort can do. From the start, most of the working forces of the TVA took their work as a matter of deep personal interest; this spirit made things move. By now flood-control planning is well advanced, while water conservation and navigation improvement have made large strides in plans and in work done.

SOURCE OF TVA FUNDS AND EXPENDITURES TO JULY, 1936

TVA Funds

Direct Appropriation		
1933	$50,000,000	
1935	36,000,000	$86,000,000
Allocation from Work Relief Funds		25,000,000
Sales		800,000
Net Power Revenues		1,400,000
Total Funds received to July 1, 1936		$113,200,000

(Authorized bond issue, $50,000,000; none issued)

TVA Expenditures

Dams including surveys, engineering, lands, construction camp, villages and roads	$82,000,000
Power Transmission Lines and Substations	8,500,000
Fertilizer Plant and Operation	5,000,000
Forestry, Land Planning, etc.	1,000,000
Muscle Shoals and Nitrate Plant Expenditures (National Defense)	2,000,000
Materials, Supplies and Miscl.	1,000,000
Total Expenditures to July 1, 1936	$99,700,000
Funds	$113,200,000
Expenditures	99,700,000
Balance of Funds	$13,500,000

PRINCIPAL CONSTRUCTION OPERATIONS OF TVA

Norris Dam
- Construction begun — Oct. 3, 1933
- Storage begun — Mar. 4, 1936
- First power generated — July 27, 1936

Wheeler Dam
- Construction begun — Lock (Army) Jan., 1933; Dam Nov. 30, 1933
- Storage begun — Oct. 23, 1936
- First power generated — Nov. 1, 1936

Pickwick Landing Dam
- Construction begun — Mar. 30, 1935

Guntersville Dam
- Construction begun — Dec. 4, 1935

Chickamauga Dam
- Construction begun — Jan. 13, 1936

Hiwassee Dam (Fowler Bend) — July, 1936

Wheeler-Norris Transmission Line
- Surveys begun — Sept. 1933
- Construction begun — Feb. 28, 1935
- Completed — July 28, 1935
- Placed in service — July 28, 1935

Where the money comes from

As everyone knows, public improvements such as river and harbor work must be financed from general public funds. The TVA's work is essentially a non-revenue enterprise, except for the incidental power revenues, and while the act directs that these revenues shall be applied toward liquidating the cost of the work, it does not contemplate paying for all or a major part of the improvements from this source. Actually power revenues cannot amount to large sums during the early development period.

TVA operations were financed in part from allocations of emergency relief-work funds and in part by Congressional appropriation. The legislation also authorized the TVA to isue bonds, but no use has been made of this authorization to date.

The total funds provided and their use are indicated by the figures in the accompanying table.

The total money supplied to TVA is $113,000,000, not counting the authorized bond issue, of which no use has been made to date. Total expenditures to last July were almost exactly $100,000,000.

The experiment today

Through all the complication above outlined, a comprehensive development plan has been evolving in the Tennessee Valley, and one by one some of its most costly units have been built. Floods have been reduced, low streamflow has been increased, water has been conserved, and parts of the ultimate navigation waterway have been completed.

On the other hand, harmonious and thorough cooperation of the local governments is still quite shadowy. And, finally, no one can yet judge whether the ultimate balance sheet will show the TVA to be good business or not.

Thus, the TVA experiment in comprehensive stream development is still far from a proven success—more in governmental and human relations, in operation and in financing than in technical matters. But the progress already made gives promise that the remaining problems, difficult though they may be, will also be worked out. Already a precedent and a model for all future river development undertakings is being created.

Full understanding of the progress of the experiment, however, requires knowledge of the actual working problems and how they are being dealt with in their principal phases. These matters will be discussed in succeeding articles.

Who runs the job

The men responsible for the enterprise as a whole are the three board members who constitute the Authority—the two Morgans and Lilienthal. Chairman of the board, Arthur E. Morgan, also is chief engineer, though the detail direction of the extensive engineering and construction operations is largely in the hands of Carl A. Bock, assistant chief engineer. Headquarters are at Knoxville so far as actual work is concerned; the corporate office is at Florence.

The second article on the TVA, dealing with water conservation and flood control, will appear in next week's issue.

City and Federal Relationships Discussed by Municipal Officers

CARRYING ON a depression-born tradition, 140 city officials, members of the United States Conference of Mayors and its affiliated organization, the Institute of Municipal Law Officers, met in Washington in November 16-18. As at previous sessions, relationships between the cities and the federal government received the greatest amount of attention, although problems relating entirely to municipalities were also discussed.

Keynote of the conference was struck by its president, Mayor F. H. LaGuardia of New York, who opened the session by pointing out that the last few years have brought the cities into much closer relationship to the federal government than ever before. This has been primarily due to the problem of unemployment relief, which is still far from being solved. In order to finish out the fiscal year ending June 30 next, LaGuardia estimated, Congress must appropriate an additional sum of at least $500,000,000. (This figure was later increased to $900,000,000 by Mayor E. J. Kelly of Chicago.) Emphasizing the fact that he was merely stating his personal views, the New York mayor endorsed the general principle that the local governments should care for unemployables, while the relief of employable persons unable to secure work should be the task of the federal authorities. In support of this he pointed out that general unemployment is a result of national maladjustments to correct which the cities can do little.

Mayor LaGuardia also favored a continuation of the PWA program, and proposed that the conference consider the setting up for a unit in the federal reserve system to which cities could turn for financing or refinancing, a unit in the Federal Trade Commission to deal with unfair trade practices in relation to municipal purchasing, and take steps leading to the establishment of some form of inter-city civil service for technical employees.

Unemployment relief

Harry L. Hopkins, WPA administrator, was the principal speaker in a session devoted to the relief problem. He looked backward to quote figures indicating that there has been serious unemployment, even in periods of prosperity, for nearly fifty years, and forward to predict that "under our present system we will have to face indefinitely the fact that many people will want jobs who cannot find them." Admitting the difficulty of estimating the proportion of able-bodied employables, Mr. Hopkins advocated periodic unemployment censuses to secure a fairly exact picture of conditions at regular intervals. Taking into account the increase in productability of the average worker due to improved technology and mechanization, and the growth in population, he estimated that total production volume must climb 20 per cent above the 1929 level to reduce unemployment to the amount obtaining at that time. In terms of present production, this will mean an increase of 45 per cent.

The history of the U. S. Employment Service, which coordinates the work of municipal and state placement services and also maintains agencies of its own where there is no local organization was reveiwed by W. Frank Persons, director. Public employment offices are now operating in every city of over 75,000 population but one, and only 59 cities of over 25,000 are without such an establishment.

Other federal-city relations

Apart from relief, several other fields in which the activities of municipalities touch upon those of the federal government received attention. Secretary of the Interior Harold L. Ickes discussed housing activities in the low-rent field, which he termed "the most vital social challenge before us today." During the emergency, he pointed out, it was necessary for the federal government to carry through the program of construction now approaching completion, since the cities were unable to do so. In the future, however, it will be primarily local initiative that will determine the extent to which each municipality will alleviate housing conditions, with the national government giving them aid and counsel.

The Secretary also discussed briefly the future of other branches of PWA activity. Admitting that he was merely expressing his hopes, and not making a prediction, he voiced his conviction that "the soundest possible public policy at a time of economic depression is the prompt undertaking of a far-flung program of substantial public works," and that for real effectiveness such a program should be planned in advance. For this reason he suggested that PWA should not only be extended beyond its present expiration date of June 30, 1937, in order to complete its present program, but that it should be made a permanent agency of the government to form a "public works general staff." He also advocated further allocations "to round out and complete our program," subject to general retrenchment and to the limitation of further work to communities lagging in recovery; abandonment of the fixed 30 per cent or 45 per cent grant allowance in favor of a sliding scale based upon the actual need of the individual applicant; and the use of PWA as a borrowing source where private loans are not available at reasonable interest.

Arthur E. Morgan, chairman of the Tennessee Valley Authority, predicted the rise of forms of public organizations that would cause "the sharp lines between city, county, state and nation to fade." These organizations would be modeled after the numerous water, sewerage, school and park districts now

in existence. Their purpose would be the accomplishment of some specific objective overlapping several jurisdictions. "If the government is to serve the people well it must develop greater flexibility and adaptability," said Mr. Morgan. "Private industry has reached its high development by that method, and public business should follow its example."

Resolutions

The results of the active discussion program were readily apparent in the group of resolutions adopted by the Conference. Without dissent, the attending mayors approved:

1. Continuation of the federal works relief program for destitute employables, with the cities and states caring for unemployables.
2. Completion of the present PWA program, and the creation of a permanent PWA to prepare a long-time public works program.
3. Adoption by Congress of a permanent program for the relief of transients.
4. Passage of the Wagner housing bill or similar legislation.
5. Study of a plan to consolidate various activities of the federal government, such as work relief, public works construction, employment offices, and social security, into a single Department of Public Welfare.
6. Creation in the Federal Trade Commission of a special unit to police bid collusion and other unfair trade practices in the field of municipal purchasing.
7. A survey by the federal government of the broad field of municipal financing.
8. The adjustment of present inequalities in the handling of municipal claims against various federal departments and agencies.
9. Preparation by its officers of a plan leading to the establishment of qualification standards for technical city employees, and the preparation of lists of qualified applicants from which selections might be made.
10. Appointment of a committee of five members to work with the federal government in obtaining natural gas service at reasonable rates for cities desiring it.
11. Extension of the Railway Labor Act, or enactment of similar legislation in other fields, regulating labor disputes in all fields of interstate transportation.

Officers re-elected

Breaking established precedent, the Conference, in view of the importance of relations between the cities and the federal government during the coming year, re-elected its entire staff of officers, including the following: President, Fiorello H. LaGuardia, New York; vice-president, Edward J. Kelly, Chicago. Trustees are: Frederick W. Mansfield, Boston; Neville Miller, Louisville; Angelo J. Rossi, San Francisco. A vacancy on the board of trustees was filled by the election of Ross D. Rogers, Amarillo, Texas.

Drill Dust Control Equipment Tested by New York State

APPARATUS of the exhaust type for the control of rock drill dust is being tested by the state industrial board of New York at a field laboratory in Letchworth Village, Rockland County. The tests are in accordance with a requirement of the state's recently-enacted silicosis law, by which approved dust control equipment is mandatory on all rock drilling operations. Approval will be given only to apparatus shown by testing to be capable of reducing the dust created by drilling to less than 10,000,000 particles per cu. ft. of air. The test procedure is incorporated in a code of rules and regulations governing administration of that part of the silicosis act pertaining to rock drilling and excavation, prepared by a special committee representing all interests concerned. Formal approval of the dust-control equipment awaits adoption of the code by the state industrial board, though in all probability temporary approval will be granted to satisfactory apparatus.

Test procedure

Tests are being made on an outcropping of extremely hard bastard granite, estimated to contain about 50 per cent quartz or free silica. To eliminate the effect of wind and air currents hand drill or jackhammer tests are made within a 10x12-ft. shack resting on a flat ledge. Drifter and stoper tests are conducted against a triangular 10-ft. face blasted out of a high outcrop, enclosed by canvas roof and walls. Admittedly the test conditions are more severe than probable actual working conditions, and the test results are therefore conservative. Jackhammer drilling is never carried on in an enclosed and restricted space as represented by the shack, except possibly in shaft sinking, and then the top would be open or at least far above the working level. Drifting test conditions resemble those of a tunnel heading, except that the working space is fully enclosed without benefit of natural or forced ventilation. Stoping tests are severe, for stope holes must be cut into a vertical face at an angle of 60 deg., and the exhaust hood can not be set as close to the mouth of the drill hole as would be possible in vertical drilling.

In the exhaust type of drill dust control, a hood through which the drill steel passes covers the drill hole. From this hood all of the dust created by the drill is conducted by air suction through a hose to a cleaning device, which is usually arranged in two stages; the first separating the coarse particles from the air stream by means of baffles, while the second takes out the finer dust by cloth filters. Suction is provided by exhaust fans or by air jets.

Nine dust samples

The test procedure requires a three-hour run on each type of drill. All drills are run dry. Jackhammers must drill at least 15 ft. of hole per hour, drifters 20 ft. per hr., and stopers 12 ft. Drills are operated for one hour before the first air sample is taken, and then three samples are collected in the next two hours of drilling at three different locations: the general outside atmosphere, at the breathing zone of the drill runner, and at the exhaust of the dust control system. Samples are caught with Greenberg impingers, and the dust concentration is determined by light-field microscopic counting.

In addition to the dust sampling, other operating tests are made on the equipment. The airflow through the hood is measured, and the pressure drop through the hood up to the collector is determined. The pressure drop through the collector and at the entrance of the fan or jet is also measured. The purpose of the operating tests is to determine that the characteristics of the control system are such that the airflow will not drop off after continuous use to a point below that necessary to keep the dust concentration within safe hygienic limits.

All applicants for tests must furnish their own dust collecting apparatus, drills, drill steel, hose, piping, compressor and operators. Detachable bits have been used exclusively, as there is no provision for sharpening steel. The state furnishes the testing equipment, such as impingers, airflow meters and pressure measuring devices.

To date tests have been made on three makes of apparatus of the exhaust type. No application has been received by the state for testing wet drills, though wet drilling has long been regarded as a method of dust control.

The testing is under the direction of Theodore F. Hatch, associate dust control engineer, division of industrial hygiene of the state department of labor and industry. Elmer F. Andrews is industrial commissioner, and Dr. Leonard Greenberg is executive director of the division of industrial hygiene.

CONTROL OF ROCK DUST IN CONSTRUCTION—II.

Practical Control Equipment and Methods

By Theodore F. Hatch,
Associate Dust Control Engineer, Division of Industrial Hygiene, New York State Department of Labor

LAST WEEK *the first article in this series discussed the health and medical aspects of silicosis, a lung disease caused by continued exposure to rock dust containing free silica. Obviously, since silicosis is a product of rock dust, control of the dust is the most logical means of preventing the disease. The following article describes several practical methods of dust control. Mining experience is freely mentioned, because in this industry the dust problem has been long recognized, while in construction it is a newly-discovered health hazard. Also, mining is related closely enough to rock excavation in construction to make its experience valuable to our own industry. Next week's article will give the status and trend of silicosis legislation and compensation.*
—EDITOR.

ONE FACT of great practical importance stands out in the store of information that has been gathered from investigations of the industrial dust hazard: Silicosis results from the continued breathing of air charged with quartz-bearing dust and can be eliminated from an industry only by a reduction of the dust concentration below a certain safe level. The most striking proof of this statement is found in the experience of the gold mining industry of South Africa (Fig. 5). Starting early in the century with dust concentrations of more than 100 mgs. per cu.m. and a silicosis incidence of 30 per cent, the dustiness has been reduced as the result of a continuous and effective dust-control program until the average concentration in the mines is no higher than 1 mg. per cu.m. and the Miner's Phthisis Commission is able to report that "No new Rand miner who has entered the industry since August 1923, 10½ years ago, has yet contracted silicosis." No amount of legislation or provisions for workmen's compensation alone can accomplish this.

In the construction industry, a potential silicosis hazard exists whenever rock containing quartz is drilled, blasted and excavated. Underground operations in confined spaces are the most dangerous but workers in open excavation are also exposed to a hazard which varies in degree with the magnitude of the natural ventilation by wind currents. The dust exposure is very much less when the drilling operations are in an open, wind-swept area than when the work is carried on in a pit or quarry or an excavation surrounded by tall buildings. It is difficult to measure the extent of the hazard by medical and statistical surveys as rock-workers in this industry do not remain on one job for long. The effect of breathing silica dust is cumulative, however, and may lead to silicosis even after the worker's exposure ceases. Hence, the fact that a construction job will not continue for more than a few months does not take away the need for dust control, although it does complicate the problem of workmen's compensation.

Construction's problems

The temporary nature of construction work also increases the difficulty of applying control measures compared with the problem in a stationary and permanent factory or mine. Equipment must be portable or semi-portable; it should be capable of expansion as the work progresses and should be applicable to different types of jobs. In this respect, however, dust control equipment does not differ from other machinery used in the industry and should present no serious obstacle to construction engineers and superintendents who are constantly faced with this problem in the design of equipment and selection of methods.

Principle sources of dust are: rock-drilling, blasting, mucking and other rock-handling operations. Of these, drilling probably produces the greatest amount of dust (50 gms. or more of

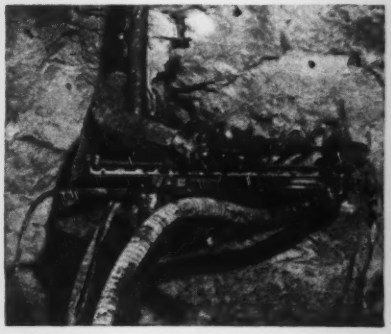


FIG. 1—CONTROL EQUIPMENT of the exhaust type has been developed for the three common rock drills, the stoper, drifter and hand drill or jackhammer, as shown in these three views from left to right. In all cases the dust is caught by a trap at the mouth of the drill hole and is conducted to a collector or separator by air suction.

FIG. 2—EFFECTIVENESS of dust control on open-cut work is shown by these typical "before and after" views. This exhaust system is of the central type, the dust being conveyed from each drill through a manifold to a header that leads to a large stationary separator.

particles less than 10 microns in diameter per foot drilled.) I found that a jackhammer operating at a rate of 100 ft. a day generates more than one billion dust particles a minute. It is frequently stated that blasting produces the greatest amount of dust; I believe that this statement is not always true. When wet drilling is employed, blasting undoubtedly causes the greatest dispersion of dust into the atmosphere since in addition to that actually generated by it, the blast also dislodges some of the dust from the rock walls and floor previously deposited there by the wet drilling operations. In contrast, when the dust produced by dry drilling is captured and conveyed to a remote collector, the dust from blasting is reduced to the amount actually generated by the explosion. The difference has not been determined.

Dust control

Methods for control of the silicosis hazard include: (1) wet drilling and wetting down walls and muck piles; (2) general ventilation; (3) dust exhaust hoods on drills and over mucking operations and other local sources of dust and (4) personal protection by means of respirators and positive-pressure masks. Of these the first is the most widely used in the mining industry; in construction work it is employed in tunnel operations as well as surface excavation work but its usefulness is limited when freezing temperatures are encountered. It also produces objectionable working conditions especially for stope hammer operators and is certainly to be avoided if a pneumonia hazard exists. All dusts are not captured in water to the same degree. The effectiveness of wet control depends in part upon the nature of the rock; the determining factors are now under investigation at the University of Birmingham, England. In my experience, water is less effective against quartz-bearing rock than against silica-free material. The ordinary wet drill, which permits a mixture of air and water to pass down the drill steel provides poorer control than the special South African machine which delivers only water to the drill-hole, for considerable dust is dispersed into the air with the water droplets which escape in the air-water mixture from the American drill.

A fundamental objection to all wet methods is that the dust is simply suppressed near its source and remains on the rock surfaces to be dispersed by any subsequent disturbance such as blasting.

The most extensive experience with wet control has been had in the Rand mines and a review of the South African regulations should therefore provide some useful information. The important regulations may be summarized as follows:

1. An adequate amount of clean water must be supplied to all points of operation at a pressure of 30 lb. per sq.in. when all equipment requiring water is in use. The water must be free from silica particles.
2. Rock surfaces must be thoroughly wet down for a distance of 25 ft. back of the operating face before drilling is started and kept wet during the working period.
3. No mucking or rock-handling may be done until after thorough wetting down.
4. Wet drilling is required at all times and an extra stream of water must be directed toward the drilling point during collaring.
5. Holes must not be blown out by compressed-air except when adequate water is present.
6. Strong water blasts directed toward the rock face must be turned on before blasting and remain in operation for 30 min. after shooting.
7. Atomizers are required over ore bins, ore-passes and grizzlies.
8. Surface dumps from which dust may be blown by the wind are sprayed whenever necessary with a sludge of black soil.
9. Complete plans of the water supply system and connections must be kept in the office and a regular schedule of inspection and maintenance followed.

There can be no doubt that the strict adherence to this series of regulations has resulted in a high degree of control of the silicosis hazard in the Rand mines, although it is impossible to say how much of the improvement can be credited to wet methods and how much has resulted from the greatly increased capacity of general ventilation. Recent statements indicate the belief that the limit of effectiveness of dust control by water has been reached on the Rand and that further improvement must come through the development of suitable system of exhaust hoods and ventilation.

An objection to the widespread use of water in deep, hot mines or other high-temperature working places is the fact that the atmospheric humidity is raised to an excessive level. Attempts have been made to keep dust down and yet avoid this objection by spraying rock surfaces with calcium chloride or other hygroscopic material. Beneficial results by this means have recently been reported in the Arizona copper mines although the use of salt was abandoned in certain other mines. The application of a sticky substance like molasses to the mine walls was proposed some years ago in South Africa but has never been employed on a practical scale. Attempts have been made to increase the efficiency of control of drill dust through the use of foam-producing substances in the drill-hole rather than water. Recent reports indicate marked reduction in dustiness from the level of dry drills without dust control by this means but the concentrations obtained were still very much in excess of the permissible maximum for quartz-bearing dust.

General ventilation

Two precautions must be taken to insure effective general ventilation: first the fresh air supplied to the tunnel or other confined space must be free from

dangerous dust and second, it must be properly distributed through the workings to provide a maximum degree of mixing with dust-laden air. The first introduces no great difficulty and is usually provided for simply through careful selection of the location of the air inlet. The second is relatively easily secured in a tunnel but becomes increasingly complicated as the number of working faces increases. The problem of air distribution is, of course, a serious one in general mine ventilation and may require the construction of special ventilating shafts and other airways and brattices to control the air flow. Air is easily supplied to a tunnel heading through light metal pipe or canvas duct which is extended as the face progresses. In some operations the main ventilating current may not be carried into dead-ends; in such cases local booster-fans or air-ejector pumps are installed to insure adequate circulation between the dead-end and the supply of fresh air.

General ventilation cannot be depended upon alone to reduce the dustiness from rock-drills to a safe level as the quantity of air required to effect the necessary degree of dilution is too great to be practicable. The jackhammer, for example, which generates one billion particles a minute, will require an airflow of 10,000 cu.ft. per min. per drill, with perfect mixing, to reduce the dust concentrations to 10,000,000 particles per cu.ft. of air. Since mixing is never perfect, the actual ventilating rate required would be even higher. General ventilation should be employed only as an adjunct to another control measure.

General ventilation is required, of course, to remove undesirable gases and smoke after blasting in a tunnel or other confined space.

FIG. 3—ROCK DUST CONTROL on excavation of a rock cut in New York City, using the exhaust method; the dust collector in the foreground is trapping the dust created by the wagon drill at the right.

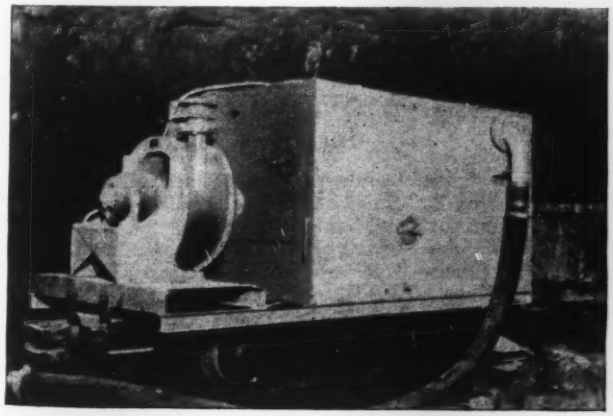
Dust can be removed effectively as it is produced by a rock-drill through some sort of a dust trap which surrounds the drill steel at the rock surface. By means of suitable supports, the trap can be used with the drill in any desired position. Traps of different design are employed for different drilling operations and the rate of airflow through the hood is varied to meet the requirements of the job. The dust is captured as it emerges from the drill-hole and is conveyed by the air stream through flexible hose and pipe to a suitable dust collector in which the air stream is freed from its dust load and thus discharges as clean air.

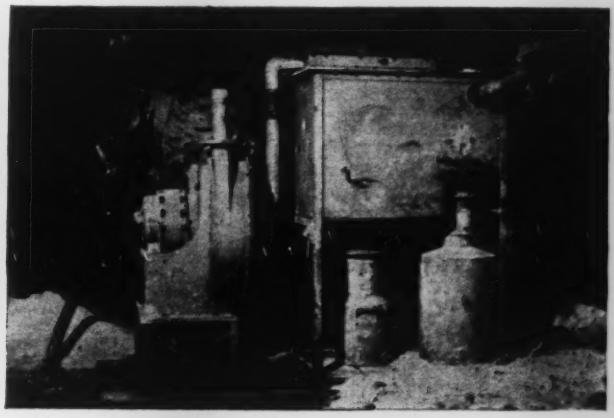
Typical dust traps are shown in operation on the jackhammer, drifter and stoper types of drills in Fig. 1. The apparatus must be capable of reducing the dustiness below 5,000,000 particles per cu.ft. (standard impinger counts) in the air discharged from the apparatus as well as at the breathing zone of the drill operators. Repeated tests have shown that this is possible with equipment of the proper design and capacity. Thus Fehnel reported dustiness of one to four million particles per cu.ft. for dry drifting and stoping with dust traps in use, compared with ten to fifteen million for wet drilling in both cases, and over 200,000,000 for a dry drill with no dust control (Determination of Effectiveness of Dust-Control Measures Used in Mines, Tech. pub. No. 637-A, 60. Am. Inst. Mining & Metal. Engrs., Aug., 1935). Dust determinations for the purpose of measuring control efficiency should never be made until after at least 1 hr. of operation since this time is required to bring the apparatus into balance with the surrounding atmosphere.

Design—Equipment may be supplied for only one drill or it may have a capacity of 100 or even more machines. It may be portable or semi-portable in form (Fig. 4) and is easily expanded as the work progresses simply through the addition of units. If the apparatus is ruggedly built, it may be used over and over again.

In the case of a multiple system the exhaust piping must be arranged to provide flexibility of operation. For use at a tunnel heading the collector may be mounted on the drill carriage or on a suitable truck to permit easy removal before blasting or it may have a semi-permanent mounting in a side niche from which the suction line is extended

FIG. 4—UNDERGROUND installations of dust collectors of the exhaust type. At the left is a rail-mounted portable separator that is kept close to the heading; at the right is a semi-portable collector drawing dust from stoper operations 200 ft. overhead.





as the tunnel progresses. Equipment must be small enough to enter shaft and tunnel. On open excavation by the bench system a layout such as that shown in Fig. 2 may be employed; 2-in. flexible hose connections from the manifolds to the drills are long enough to reach all parts of the job. The air velocity in the exhaust piping must be high enough to insure continuous transportation of the dust to the collectors; 3,000 to 4,000 ft. per min. is required.

The dust storage capacity in the collector should be sufficient to hold the supply of a full working period; for the jackhammer 1.5 cu.ft. storage space is required for 4 hr. operation. A satisfactory rate of filtration is 3 cu.ft. of air per sq.ft. of cloth area per minute while the rate of dust loading on the filter should not exceed 10 grains per sq.ft. of cloth area per min.

Experience has demonstrated the practicability of this method of drill-dust control and has also shown a moderate cost of operation. In one case the charge amounted to only 1.05 per cent of the total cost of removing the rock and only 6.3 per cent of the drilling cost. In another case, where the use of dust traps increased drilling speeds, the charge for dust control was practically nil. Both of these were large open-excavation jobs employing 25 or more drills.

According to Mechin (Tech. Pub. No. 637-A, 60. Am. Inst. Mining & Met. Engrs., Aug., 1935) drilling speeds are increased 30 per cent in mine raising, while in drifting the speed of drilling was about the same as with wet drills. In the latter case, however, a 50-per cent reduction in the amount of drill steel used was effected through the use of the dust traps.

Local Exhaust During Mucking—Control of drill dust by means of local exhaust hoods eliminates only one source of dust. The dust dispersed during mucking and other rock-handling operations, however, can also be reduced by this means and requires the use of no elaborate hoods. Through the simple expedient of mounting a plain metal hood with a rate of airflow of less than 300 cu.ft. per min. at the end of the mine car, Fehnel (see references above) reported a reduction in the dust concentrations from eighty to eight million particles per cu.ft. while the car was being loaded with ore. The design, location and capacity of the hood must vary from one job to another, but the control of mucking dust certainly presents no difficult problem.

Ore Tables and Bins—In the Rand mines tables and bins have been provided with exhaust ventilation by means of which the dustiness is reduced from 3 mgs. per cu. meter to as little as ½ mg. per cu. meter. One installation, described by E. P. Cowles and R. A. H. Flugge-Smidt, in *Journal* Chem. and Metal. and Mining Soc. of So. Africa, Sept., 1934, is a series of hood intakes and fan blowers, located near the working tables, which attract the dust and blow it into a common header ending in bag filters. The filters are located beyond a bulkhead wall in the mine workings. In the strictest sense, this is not local exhaust ventilation, as no attempt is made to enclose the dusty process with a hood. It is, on the other hand, what one might term general air cleaning in a localized area. From 20,000 to 40,000 cu.ft. per min. of air are drawn away from the area, filtered through the bags and returned to the general mine air. A number of these cleaning plants are in satisfactory operation in South Africa. Aside from general air cleaning, these local filter plants have been found to clear up the atmosphere rapidly after blasting and thus permit operation in two shifts whereas under ordinary conditions only one shift per day is allowed. There is no reason why similar equipment cannot be installed for general air cleaning in tunnel and other underground construction jobs. The cost of construction and operation would be moderate.

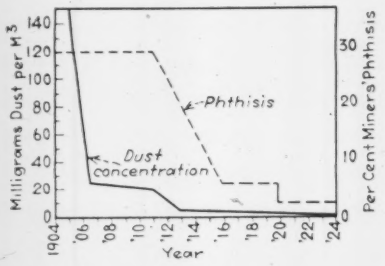


FIG. 5—PROOF of the reduction of silicosis cases (miners' phthisis) in relation to control of dust is shown by this chart of experience in South African mines.

Respirators

There are two general types of respirators which, when properly fitted to the face of the wearer and worn continuously in the dusty atmosphere, provide individual protection. One is the positive-pressure type, a hood that completely encloses the head of the wearer and supplies fresh air from an outside source; the other is a filter mask worn over the nose and mouth of the worker. Both types, which meet the requirements of the U. S. Bureau of Mines with respect to efficiency and quality, are now on the market.

One basic objection to individual protective apparatus militates against its general use against dust: protection is obtained only while the respirator or mask is worn; because of their discomfort, however, workmen object to their continued use and wear them only under the strictest regulation. They are particularly objectionable in a hot, damp environment.

Respirators and masks have a legitimate place in the field of dust control, especially on infrequent or unexpectedly dusty operations but cannot be recommended for continued day-long protection against a hazardous dust.

Control procedure

1. Determine composition of rock to be encountered in the course of the work and the permissible concentration to be maintained. The insurance company and state departments of health or labor are the best agencies through which this information can be secured.

2. Determine the best method of control—whether wet or dry, or a combination of the two. The efficiency of wet drills is best determined by actual test against the particular rock in question. Questions of freezing, high humidity, flexibility, speed of drilling and cost must be considered, as well as efficiency of control in the selection of method.

3. Lay out equipment to allow for expansion and progression of the job; the selection of a portable or stationary collector must be determined in advance and the reclaim value of the apparatus considered in estimating the cost.

4. If respirators or positive-pressure masks are to be used, purchase only those approved by the U. S. Bureau of Mines. It is not enough simply to supply each man with a respirator. A regular schedule of inspection and maintenance must be instituted if they are to be used effectively.

5. Put the responsibility for dust control in the hands of one man—possibly the safety engineer—whose duty it will be to organize and enforce the necessary regulations and provide regular inspection and maintenance. He should be provided with a routine dust-determining instrument for checking the efficiency of control. Without continued inspection and maintenance and continued support from the job superintendent, effective dust control is doomed from the start.

Next week: The status and trend of Silicosis legislation and compensation.

National Forest Service Increases Timber Sales

THE RECEIPTS of the National Forest Service from timber sales, grazing fees, and other charges for the fiscal year ending June 30, 1936, totalled $4,062,963, representing an increase of $774,363 over the preceding year. As provided by law, 25 per cent of the receipts will be turned over to the individual states for the use of the counties in which the National Forests are located.

CURRENT HIGHWAY PROBLEMS—X

Road Users' Taxes

Origin, volume and misuse of motor vehicle and gasoline taxes with a suggestion for reform on the basis of benefits received from such taxes.

By Roy F. Britton
Director, National Highway Users Conference, Washinton, D. C.

FEW SPECIAL TAXES *have met more complete popular acquiescence than the gasoline tax and the motor vehicle license fee. So favorably have these imposts been accepted that acquiescence has courted abuse. Short-sighted legislators and administrators are rapidly developing all the evils forecast by students of public finance for the indiscriminate use of the sales tax. The greater evils, as the spokesmen for road users regard them, are the diversion of user taxes to other uses than highway improvement and the increase in rates due to wide substitution of user taxes for all other charges for roads. In the article that follows, these are the evils against which argument is directed. They, however, are only a part of the confusion of purpose and complexity of administration that characterize present special road-user taxation. Unsponsored distribution, outrun administrative facilities, exemptions and refunds, bootlegging and adulteration, all have developed into menaces that call for a thorough revision and unification of road-user tax legislation.*—EDITOR.

MOTOR VEHICLE taxation, almost nonexistent until the last two decades, now is rooted deeply in the field of public finance and constantly is growing. Based upon ownership and operation of more than 26,000,000 passenger cars, trucks and buses, it now affects the vast majority of families and business enterprises in this country. The important presence of this lively and expanding type of levy calls for a careful study of future possibilities as they are indicated by past developments and present conditions.

Motorists pay their way

The fact that two types of levies, property taxes and special taxes, are placed upon ownership and use of motor vehicles provides the starting point for such a study. While property taxes are not the subject of this discussion, it must be kept in mind that motorists do pay all ordinary taxes in addition to their many special-class taxes.

Revenue from the property taxes is used, of course, for the general support of the state and local governments, just as proceeds from other property taxes are utilized. Thus, by simply possessing a motor vehicle, a citizen pays more for the general services of government than otherwise would be the case. Property taxes are levied on motor vehicles in 32 states and the District of Columbia; they yield about $40,000,000 annually, it is estimated. In 16 states which have adopted the registration fee and gasoline tax in lieu of taxation on the vehicle itself, this action has been taken on the theory that heavy motor contributions relieve taxpayers generally of road-construction and maintenance costs. Today, with most of the main-traveled roads included in state highway systems, 38 states levy no general property tax for *state* roads and 43 states make no appropriations for *state* roads beyond appropriations of revenue from special taxes paid by motorists.

Motor vehicles themselves comprise only a portion of the property linked with highway transportation upon which governmental units draw heavily through taxation. Thousands upon thousands of buildings and other properties used in connection with motor transportation represent great expansions of tax rolls from which cities, counties and states derive their property tax proceeds.

In addition to the great volume of new general tax revenue which has reached the state treasuries directly as a result of the development of motorized highway use, this new transportation method is bearing a huge and entirely unjustifiable burden of federal special-class taxation for general governmental purposes. This merits a word in passing.

During the World War, the federal government imposed excise taxes on motor vehicles, accessories and tires which remained in effect for several years after the war. In 1932, in addition to reimposing the former taxes, it levied a tax of 1c per gal. on gasoline. This was increased in 1933 to 1½c. was reduced to 1c. Jan. 1, 1934, and has been extended to June 30, 1937. In 1935, the federal government collected over $259,000,000 in excise taxes on motor vehicles, parts, tires, oil, pipe lines and gasoline, or an average of $9.89 per car for the country as a whole. There is a strong sentiment that the gasoline tax should be reserved to the states for road building purposes, and 21 state legislatures have memoralized Congress to repeal the federal gas tax. More than 30 national organizations have expressed their opposition to this tax.

Users taxes grow

We are concerned here, however, with the user-charges for highways; that is, with special taxes paid by motor vehicle owners in the form of registration fees, drivers license fees, gasoline taxes and special motor-carrier fees and taxes.

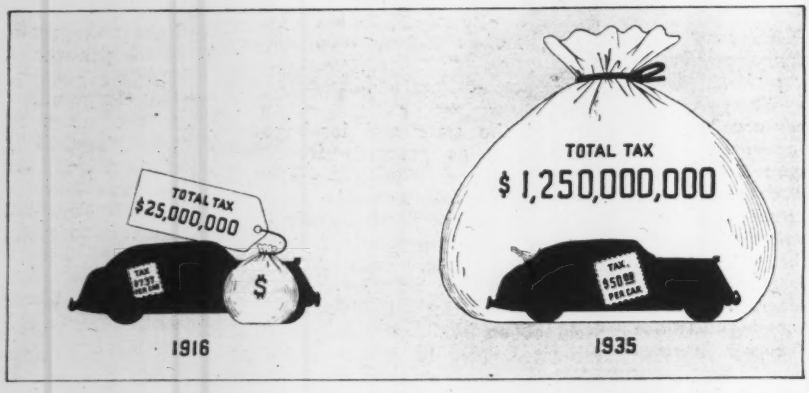
The first form of special tax on the motor vehicle owner was the registration fee, which first made its appearance in New York in 1901. Originally, this was not intended as a revenue producer. The principal function of the registration laws was to provide a system of identification. The validity of these laws depended upon the license tax theory, as it was the well-settled law at the time that the revenue derived from a regulatory measure should not be more than was necessary for the proper administration of the law. Therefore, in most of the states, the original laws provided for a flat registration fee of from $1 to $3 per car.

As the use of the automobile increased, car owners naturally demanded better roads and expressed a willingness to pay for them through higher registration fees. Raising the rates made it necessary that some more refined method of taxing be adopted in place of a mere flat rate per vehicle. By 1914 most states had provided some form of graduation in rates for licenses; and by 1927 all except Minnesota had adopted annual registrations. At the present time there are eleven different criteria on which graduated passenger-car registration taxes are based, fifteen for trucks and thirteen for trailers. A great many states use a combination of two or more criteria as a basis for registration fees.

Motor vehicle registrations passed the million mark in 1913 and by 1925 had increased to nearly 20,000,000. The peak was reached in 1930 when 26,545,281 vehicles were registered in this

country. The registrations declined through the following years to a low of 23,843,591 in 1933; there was an increase in 1934 and in 1935 registrations were within 325,000 of the former peak. As this is written, it appears quite certain that 1936 will witness an all-time high of motor vehicle registrations.

The first state gasoline tax was adopted in Oregon in 1919. By April of that year three additional states had levied such a tax and by the end of 1929, a little more than ten years after its institution, every state in the union and the District of Columbia were levying a tax on gasoline. Today the highest tax, 7c. per gal., is levied in Florida and Tennessee; the lowest, 2c., is levied in Missouri, Rhode Island and the District of Columbia. In 1935 the weighted average of state gasoline taxes was 3.8c. The motorists' state gas tax payments now average $23.52 per car for the country as a whole.



DESPITE AN INCREASE of motor-vehicle registrations from 3,512,996 in 1916 to 26,221,052 in 1935, the average tax-burden per vehicle has become almost seven times heavier than it was twenty years ago, producing a fifty-fold increase in the total of motorists' tax payments.

We have traced the history of the various taxes levied on motor vehicle owners. The revenues from these taxes in a period of twenty years has risen from $25,000,000 to around $1,250,000,000 collected annually. The average per car of all forms of taxes has grown from $7.37 to about $50 per year.

The magnitude and weight of these taxes is an important consideration. In the ten-year period from 1926 to 1935, while the number of vehicles increased only 19.2 per cent, the revenue from taxes on these vehicles increased 94.5 per cent. Special motor taxes amounted to 56 per cent of the wholesale value of cars and trucks produced in 1935. They were three times the value of tires shipped in that year, and gasoline taxes alone amounted to 79 per cent of the value of all crude oil produced in the United States during 1935. At a price of $700 per car, the sum used for taxes could have purchased 1,751,771 additional automobiles.

A very important consideration is the fact that while manufacturers have reduced the price of their products, the rise in taxes has deprived the consumer of much of these savings. A motor car which cost $831 in 1926 could be purchased, with many improvements, for $580 in 1935. The cost of tires was reduced 55 per cent and gasoline 35 per cent during the same period, but the average tax per car increased 63 per cent.

The American Automobile Association has estimated that the value of motor vehicles in use in 1934 amounted to $5,000,000,000, with the special taxes paid comprising 25 per cent of this valuation. Thus, the average automobile owner is paying about 25 per cent of the value of his car in special taxes each year.

Roads constructed

What have motorists' taxes produced in the way of public improvements in the past two decades? There are 3,000,000 mi. of public roads in the United States. Of that total, 507,000 mi. are under state control. These are the roads, which, for the most part, are constructed entirely with special motorists' taxes and federal aid. The end of 1934 found 358,000 miles of these highways surfaced. They are the main trunk lines and carry the principal motor traffic of the country. But, in addition, 600,000 miles of local roads have been surfaced, partly with revenue from special motor taxes. Thus, about 1,000,000 miles, or one-third of the country's total road mileage, is surfaced.

Even so, much is yet to be done in road development; there are about eight motor vehicles to every mile of highway in the country, about 24 cars to every surfaced mile. Highway building is a continuing responsibility and must proceed on the basis of economic and social justification. For this reason the magnitude and weight of the motorists' tax bill is important. Unless we keep these special taxes carefully adjusted to the average motor vehicle owner's ability to pay, the law of diminishing returns will set in and decrease the revenue available for construction and maintenance.

Hazards of misuse

Misappropriation of these special taxes to purposes other than highways presents what is probably the most serious problem of motor vehicle taxation facing the country today. This ordinarily is referred to as diversion, and the term is used here to include not only the diverting of available highway funds, but the application of the revenue from special motorists' taxes to general governmental purposes.

It would be hard to point to taxes that are sounder or more defensible in theory than the two principal motor vehicle levies, the registration fee and the gasoline tax. Reduced to its lowest common denominator the gasoline tax is a tax by the mile. You pay as you ride and, when first imposed, it was assumed that you would ride as you paid. By the same token, whenever or wherever diversion is practiced, taxes by the mile become sales taxes on a special class. The distance that a citizen travels in his automobile is an absurd measure of the amount of taxes which he should pay for any purpose other than the construction and maintenance of the highways he uses.

A mass conviction is growing in motorists. If gasoline tax proceeds are not used for highway purposes, they, reason, then the gasoline taxes should be reduced in proportion to the extent that the proceeds are being diverted to non-highway expenditures. Broad extension of diversion is drawing protests from aroused motor vehicle owners throughout the country. Action taken this year by the New York state legislature in reducing the state gasoline tax from 4c. to 3c. reveals the practical effect produced in at least one instance by such protests.

In Missouri, Colorado, Maine and Kansas, constitutional amendments prohibit the use of these special taxes for any purpose but construction and maintenance of highways. In at least two states constitutional amendments prohibiting diversion will be voted upon this year; and movements are underway in other states for such constitutional prohibitions.

Ten years ago only six states used the revenue from these special taxes for non-highway purposes, and the total amount diverted was $6,000,000 in that year; but the practice has grown enormously during the depression years. The purposes for which these special funds are now being misused include substantially all of the ordinary functions of government. By 1934 some 35 states were indulging in this indefensible practice, and more than $160,000,000 was diverted during the course of that year.

Diversion, rather than highway needs, is mainly responsible for the mounting of motorists' taxes to high levels.

Who should pay?

What highways should the motorists pay for and how should the rates of taxation be fixed? Roads have always been necessary. The advent of the motor vehicle required a broader development than was necessary in the horse-drawn vehicle days. The area of travel was expanded. This required the construction of traffic ways for long-distance and high-speed travel.

The motor vehicle owners have accepted the financial responsibility for the construction of such thoroughfares, but they are not the only beneficiaries of highway construction. The beneficiaries today are the same as always. The community as a whole benefits because of increased facilities for social life and commercial pursuits, police and fire protection, transportation to schools and churches and to places of business. Certainly the adjacent land benefits because of increased value and accessibility to markets; certainly the national government benefits from a military and mail-distribution consideration; certainly the great utilities of the country benefit because their transmission lines follow the highways and they make for easier construction, maintenance and service of these lines; certainly the railroads benefit because practically all of their freight and passengers reach and leave the rails over streets and highways.

There must be a just distribution of the cost among these various groups.

In the past, highway programs were largely determined by someone's off-hand opinion as to where the roads should be located and tax rates were fixed by someone's guess as to what the rates should be. We have reached a point, however, when highway development must be carefully planned and long-range programs can only be mapped out when all of the facts are made available. Only a complete survey of roads, road traffic, road needs and road financing in every state will disclose the actual facts.

Fortunately, we are now in process of getting these facts, thanks to the Bureau of Public Roads and the surveys it has authorized and encouraged highway departments to make in most of the states. From these we may expect to ascertain what roads are of general motor use and what proportion of traffic on secondary and local roads is general. We can expect data on which to base long-range programs to meet present and future needs. And most important, we shall have the facts on which to base road budgets to meet such programs, levying such taxes as will take care of such budgets and with due regard to the obligation of their various beneficiaries and their ability to pay. Ability to pay is most important from the standpoint of motor-car owners, since the great majority of them have incomes of less than $2000 a year.

ALL-WEATHER SURFACES have been placed on one-third of the 3,000,000 miles of roads in the United States mainly through special taxation of motorists.

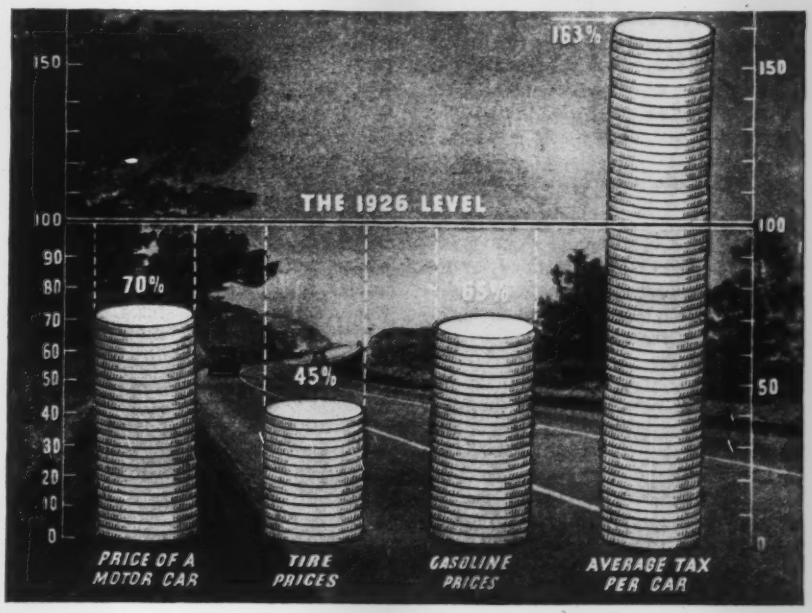
Until we have the facts we cannot be dogmatic as to whether this or that beneficiary pays its fair share. And certainly we cannot generalize, because it will in all probability be found that what holds true in one state does not hold true in others. These studies constitute one of the most important current trends in the right direction.

Long-range program necessary

In conclusion, it is obvious that we are now at the threshold of a new era in motorists' taxation and highway development. The two subjects must be considered together: they are cause and effect. Neither ill-advised enthusiasm for roadbuilding, on the one hand, nor equally ill-advised reluctance to pay taxes for an adequate highway system on the other, should be considered in formulating the intelligent long-range programs which are essential if the country is to have the full measure of efficiency from this new instrumentality of economic progress—the motor vehicle.

One thing is certain. The loose talk of subsidy as applied to highway transport is wholly without basis of fact. Whatever facts we have point the other way. Moreover, the use of the term subsidy in connection with highway transport is wholly inapplicable. As commonly understood and as any good dictionary will disclose, subsidy is a grant by government to a private enterprise. The highway is not a private

PRICES of automotive products were reduced sharply during the 1926-1935 period, at the same time that quality was improved. However, net benefit to purchasers was reduced greatly by an extreme increase in the pre-car average of motor-vehicle taxation.



enterprise. It belongs to all of the people, and is for all of them to use as contrasted with all other facilities of transportation which are privately owned. It is to be suspected that the use of the term is a mental throwback to the days when federal, state, local and municipal governments were actually subsidizing other forms of transportation, including railroads and canals.

One more popular misconception which should be dispelled is the theory that registration fees and gasoline taxes are road tolls. The Supreme Court of the United States has said that the fact "they are imposed on all motor vehicle owners without reference to any particular highway marks them as the demands of sovereignty, not of proprietorship, and likens them to taxes rather than to tolls." It is necessary to keep this concept in mind because the road-toll idea would eventually lead to a system of exactions for the use of particular roads.

Contractors Count Federal Funds For Public Works

A. G. C. makes a survey of the money appropriated or authorized by Congress for public works and of the amounts remaining for future expenditures on construction.

Extracts from a report to the construction industry by the Associated General Contractors at the Fall Board Meeting held Nov. 16-17 at Washington, D. C.

THERE ARE INDICATIONS of a revival of industry and trade which is absorbing the unemployed for whom work was created by the federal government on federally-financed public works construction. It is believed by many that continued large appropriations for relief, and even for permanent useful public works, may meet strenuous opposition in Congress. With these conditions facing the public-works program it behooves us to study the volume of business we still have available from previous appropriations and the further appropriations required to carry on the projects now authorized, and to lay plans for continuing a substantial program of public works by the municipalities, counties, states and regular federal government departments.

Available appropriations

At the last session of Congress, efforts were made to provide regular federal-public-works appropriations for the permanent federal departments, as distinguished from emergency appropriations. These efforts were quite successful. In the 1936 appropriations, there was about $110,000,000 appropriated for a regular federal-building program; about $200,000,000 for a regular program to be directed by the U. S. Engineers and the Bureau of Reclamation, and $476,000,000 for a regular program of federal-aid roads, secondary roads, grade-crossing projects and federal roads in parks, forests and Indian reservations.

In addition to the efforts made to obtain appropriations for the federal government departments a continuation was secured of the PWA program of grants and loans to local agencies to continue local programs of building construction, street and road construction and heavy construction. This resulted in an authorization to allocate $300,000,000, which should produce, all told, in the neighborhood of $600,000,000 of construction. Out of these and previous appropriations there remains the estimated volume yet to be put under construction as shown in the accompanying table.

While there remains a substantial volume of construction to result from federal appropriations, it is probable that the major portion of this will be put under construction before June 30, 1937, and the construction program to be put under way thereafter, will depend on the appropriations received from the coming session of Congress. Many of the regular departments of the federal government have received the authorization of Congress on a large volume of projects, some of which are partially completed and will require additional funds. In the face of probable public opposition to large expenditures for federal public works because of the confusion of this type of public works with relief work, a real task is ahead of the construction industry to show the coming Congress the advisability of carrying forward the work already started or authorized.

Usually Congress appropriates highway funds as needed to carry out the authorizations previously made by it. In the present situation, however, there appears to be some danger that the programs authorized by the last Congress might be postponed, or otherwise hampered. Rumors indicate that there are those who would promote the policy of utilizing federal-aid highway projects for the direct employment of the unemployed. While this could only be accomplished by amending the authorization acts already passed or by placing restrictions on funds appropriated for these authorizations, a very watchful attitude must prevail in the construction industry to see that this program receives the funds and that the program is carried out by contract as was authorized by the last session of Congress. The items carried in the authorization bills of the last session, together with the funds which the states will appropriate to match federal aid, will produce the following volume of construction if appropriations can be obtained:

FEDERAL FUNDS AVAILABLE FOR CONSTRUCTION

Building construction	
Balance Remaining of:	
1934 emergency appropriation act for federal buildings	$6,026,000
1936 deficiency act for federal buildings	15,320,000
1936 appropriation act for federal buildings	57,946,500
PWA federal housing (As of Nov. 1)	1,500,000
Appropriations, miscellaneous federal agencies	28,401,000
Total remaining of appropriations for federal buildings	$108,293,500
Value of building construction created by WPA aid from balance of funds	$200,000,000
Federal housing administration building loans remaining to be insured	$1,000,000,000
Highway construction	
Balance Remaining as of Oct. 1, 1936:	
Acts of June 30, 1933 and June 18, 1934	$11,148,000
Emergency relief act of 1935:	
Work-program grade-crossing projects	67,071,000
Works-program highway projects	35,227,000
1936–1937 federal-aid highway projects	135,868,000
State matching of federal aid funds (approx.)	130,000,000
Total remaining of appropriations for highways	379,314,000
Heavy construction	
Balance Remaining of:	
Prior to 1936—appropriations for rivers and harbors and flood control	$15,000,000
1936—appropriations for rivers and harbors and flood control	70,000,000
Prior to 1936—Appropriations for reclamation	20,000,000
1936—Appropriations for reclamation	35,000,000
Total remaining for federal heavy projects	$140,000,000
Value of heavy construction created by PWA aid from remaining funds	$200,000,000
Total volume of all types remaining to be put under construction from appropriations made up to July 1, 1936	$2,027,607,500

1938–39 federal aid—highways	$250,000,000
1938–39 federal aid—secondary roads	50,000,000
1938–39 grade crossing projects	100,000,000
1938–39 federal roads	76,000,000
State matching of federal aid	300,000,000
	$776,000,000

The federal heavy construction projects authorized by the last session and

previous sessions of Congress will produce a construction volume of $1,000,000,000. In this type of construction, however, the authorizations by Congress consist merely of approvals of definite programs of work with authority to develop the necessary plans, and actual construction contracts and operations are not authorized until specific funds are appropriated by Congress.

The authorizations for which appropriations should be sought in order to carry on a substantial part of this program during the fiscal year ending June 30, 1938, are as follows:

Mississippi River flood control	$260,000,000
Nation-wide flood control	300,000,000
Authorizations for river and harbor improvements	270,000,000
Authorizations for bureau of reclamation	200,000,000
	$1,030,000,000

It is generally believed that if the proper effort is put forth, substantial appropriations can be obtained to continue the Mississippi flood-control program and to start the nation-wide flood-control program, but it is expected some efforts toward day-labor methods on this work will have to be met. It is believed that the authorized projects for river and harbor improvements include many projects that should be completed at an early date if Congress is to get the full value out of the improvements made up to date. Appropriations for the authorized projects of the Bureau of Reclamation will require active support if a substantial sum is to be obtained in the coming year.

Local public works

There remains about $200,000,000 of the $300,000,000 that the last Congress authorized the President to allocate to PWA for loans and grants on local public-works projects, but it is probable that all of the funds the President may allocate will be put under construction prior to the close of the fiscal year ending June 30, 1937. Rumors and indications at the present time are to the effect that the administration does not now contemplate continuing the PWA program of loans and grants beyond the expenditures of funds now authorized.

There are some indications that there will be a strong demand from local officials for a continuation of federal financing of local public works through an agency such as PWA to make loans, and thus provide a market for local government bonds bearing low interest rates, so that the local agencies may continue their present public-works program, or make a start on their way to restore their programs of normal years. What part the federal government may take in stimulating the local public-works programs is still completely a matter of guesswork.

As the federal government contracts its spending for public works, there must be an expansion of local public works if we are to approach the normal volume of local and federal public works of $2\frac{3}{4}$ billion dollars annually.

Day-labor tendencies

The regular departments of government, such as the Treasury Department, Veterans Bureau, Bureau of Public Roads, Army Quartermaster, U. S. Engineers, Bureau of Reclamation, and Bureau of Yards and Docks, have in general remained steadfast to the principle of the contract method of performing public work. In spite of their general adherence to this principle, the emergency unemployment relief features of the appropriations during the past several years have increased the construction facilities used by these departments to perform their work by the day-labor method. Where they have acquired equipment and created organizations to carry on this emergency work by day labor, it will require strenuous protest to prevent a continuation of the use of these organizations and this plant in day-labor operations on the regular construction programs to come. If the volume of the federal programs handled by these agencies decreases by a large percentage, the tendency will be to decrease the contract type of construction and continue the present volume of day-labor work.

Emergency relief agencies created during the depression, such as WPA, Resettlement Administration, and the CCC camps, have expended enormous sums for relief work, of which quite a substantial part was expended on construction of some character by the day-labor system and the employment of relief labor. This day-labor activity has developed thousands of persons in supervisory positions in day-labor organizations, and has built up a considerable investment in tools and equipment. It will be quite natural to expect that these supervisors, these foremen, the clerical workers, and the technical staffs, will wish to perpetuate the day-labor system in order to keep themselves in continued employment, and their organizations intact.

There have been persistent rumors in Washington that in the reorganization of government department, there may be created a new cabinet member to administer a Department of Welfare, which would include all relief and unemployment activities, including the activities of WPA, resettlement, and the CCC camps. It is rumored that strenuous efforts will be made by these agencies to have the new department of public welfare supervise all public works and utilize public works solely for the direct employment of the unemployed and those persons on relief. If such a department and policy makes any headway, we will undoubtedly be faced with a major crisis in our fight against day labor on federal public works.

The emergency employment work of WPA and the CCC camps, working in cooperation with local public works officials and state highway officials, has developed thousands of day-labor organizations. Each of these organizations will endeavor to perpetuate itself, and when the federal expenditures lessen construction will have to be alert to see that the local public works and local highway officials do not continue the day-labor organizations for the construction of local public works and highways previously constructed by contractors.

There have been persistent and apparently well-founded rumors that persons in emergency-relief agencies of the federal government who have had some experience in the building of farm-to-market roads are now endeavoring to promote the policy of changing the entire federal-aid highway program so that all federal-aid highways in the future might be constructed by the federal and local governments jointly, using the day-labor method and the direct employment of the unemployed and those on relief. It must be remembered that many of the states are still confronted with the serious problem of raising funds for relief, and that if it was the will of Congress, a rider might be attached to the appropriation bill for federal-aid highways which would completely destroy the contract system on federal-aid highway work.

Voters Approve Government Simplification

AN IMPORTANT STEP toward the simplification of local government in the interests of economy and effectiveness of operation was taken Nov. 3 in California, where voters approved a constitutional amendment under which it will be possible by local referendum to consolidate city and county governments.

The new amendment broadens a previous constitutional provision that permitted consolidated government only for counties with over 200,000 population.

California now has one consolidated city-county government—San Francisco. The City and County of San Francisco was established in 1856. In Los Angeles County and several other counties in California, according to Robert M. Paige, secretary of the Governmental Research Association, city-county consolidation is now being advocated.

Nov. 3 also saw the ratification in Florida of a constitutional amendment which will permit city-county consolidation in Key West. This town has been practically bankrupt for a number of years. City-county consolidation is viewed as one step towards its financial rehabilitation.

Corrosiveness of Aqueduct Water Reduced by Gas Drainage

Carbon dioxide gas entering the aqueduct along part of the tunnel under Soda Hill is to be drained off through adits connected to trenches cut outside the concrete lining of the tunnel

RECENT COMPARISONS of water analyses made along the Owens Valley Aqueduct supplying the city of Los Angeles, have brought to light information which may lead to greatly decreased maintenance costs in fifteen steel siphons totaling thirteen miles in length, an important part of the aqueduct.

In the 250 miles of canals, tunnels and siphons which bring Owens Valley water to Los Angeles, effective maintenance is essential to delivery of the maximum flow and to keeping the aqueduct in condition for dependable service. An important item is keeping down tuberculation and other roughness resulting from corrosion in the steel pipe lines, mainly siphons. Although the acid content of Owens Valley water is much less than that in the supplies of some other cities, it is enough to cause corrosion and this necessitates repainting of the pipe interior at regular intervals. Particularly in siphons on a steep slope, the cost of removing corrosive incrustations and cleaning off the inner surface preparatory to renewing the protective coating is a costly operation. If the acid content of the water could be kept low enough that a natural protective coating would form inside the pipe, the cost of maintenance would be materially reduced, and the time lost by reason of taking the line out of service for the cleaning process would be eliminated.

Determinations of the corrosive quality of water at different points along the aqueduct were begun at the upper end of the line. At this point objectionable chemicals were present only in very small quantities and as the survey progressed downstream there was little change until reaching the Soda Hill tunnel near Little Lake. Here there was a sudden increase in the corrosive qualities caused by the large quantities of CO_2 gas which seep into the tunnel and dissolve in the water. From a single source, concentrated in about 7,000 ft. of tunnel, the CO_2 content rose from a negligible quantity to 4.2 p.p.m.

When the tunnel was unwatered for inspection it was found that the gas in the rock formation traversed is under enough pressure to cause a hissing sound as it enters the tunnel through any crack or small opening in the concrete lining.

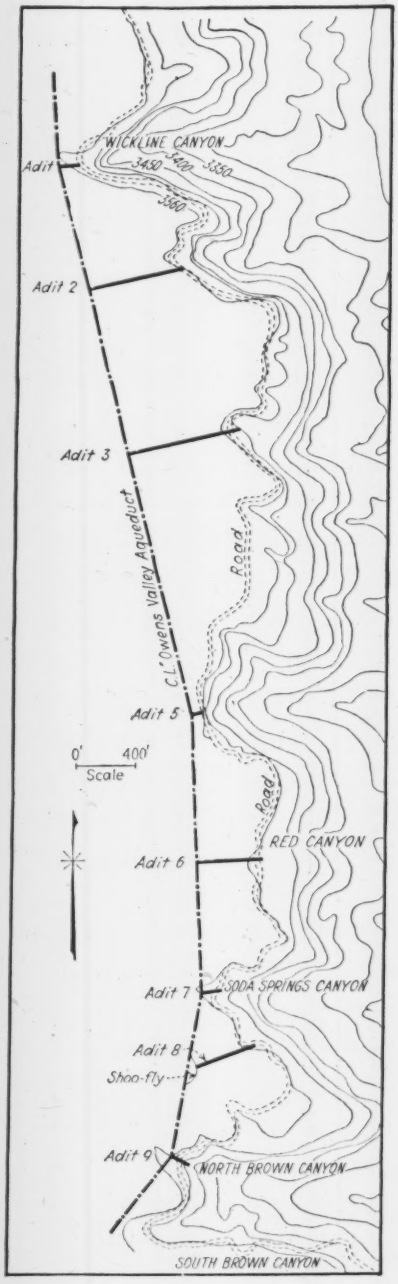


FIG. 1—EIGHT ADITS which are to be built along a section of Los Angeles' Owens Valley Aqueduct to carry carbon dioxide gas into side ravines and thus lessen the corrosive effect of the water.

Construction recently was begun on a remedial plan which takes advantage of the fact that CO_2 is heavier than air and proposes to drain off the gas from the underside of the lining. The first step is a drainage trench which is being constructed beneath the floor of the tunnel; that is, a trench is being cut beneath the concrete invert for the purpose of draining the heavy gas out through adits driven at necessary intervals.

The plan of construction is to unwater the tunnel, break out a strip of concrete 30 in. wide from the mid portion of the invert and excavate a 15x15-in. trench in the rock beneath. When the full length of trench has been excavated and thoroughly cleaned out, it will be bridged over with corrugated iron as a bottom form on which to pour concrete replacing the strip removed. Fortunately the Soda Hill tunnel is located along a hillside in which there are ravines at frequent intervals to afford convenient locations for the necessary adits. Eight adits are being driven; their total length will be about 2,000 ft. Each adit will terminate in a full-sized opening cut in the side wall of the tunnel. Six of these openings will be sealed again with concrete (except for the trench) after the trenching has been completed. The other two will be closed with iron doors, as shown in the accompanying illustration, thus facilitating access that may be necessary later.

Outlet channels provided

The expectation is that the gas will find its way by percolation in the rock around the outside of the tunnel lining and into the open trench beneath the invert, will flow thence to the nearest adit and therein will continue on a down-grade to the open air. While work is going on in the tunnel on the trenching job, care will be taken to fill any small breaks or cracks in the lining, thus minimizing chance for escape of water into the gas drainage system. At one point where a cave-in made it necessary some years ago to build a "shoo-fly" around the original tunnel, the old headings will be sealed off to keep out gas.

There is confidence in the gas drainage plan described because entire success attended a previous experiment along similar lines. In that case a 4-in. drain pipe was placed in a trench cut beneath an invert and backfilled with gravel: no water leakage occurred and the gas flow from the pipe was heavy.

If the plan under way in the Soda Hill tunnel does not provide sufficient gas drainage and if gas seepage through the lining into the water still occurs, the next step in the program will be to make a more direct path to the trench in the invert by cutting rings entirely around the tunnel lining

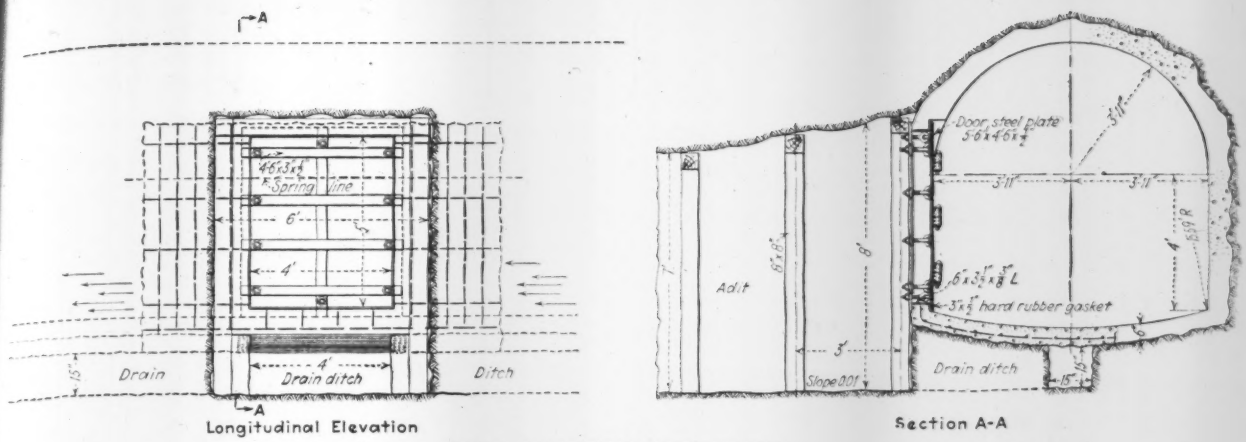


FIG. 2—A GAS DRAINAGE TRENCH cut into rock below the tunnel invert, leads to the adits on the Owens Valley Aqueduct

at intervals. These rings will be put in by again unwatering the tunnel and excavating circumferential cuts through the concrete lining and into the rock beyond. After the lining has been replaced leaving these open cuts behind it, the expectation is that the ring trenches will serve as gas collectors, feeding the trench under the invert.

The work is being done by the Los Angeles bureau of water works and supply, H. A. Van Norman chief engineer and general manager; J. E. Phillips is engineer in charge of maintenance and operation, Owens Valley Aqueduct. R. F. Goudey, sanitary engineer of the bureau made the water analysis survey.

Use of Soil Studies in Road Work Emphasized at Research Meeting

Progress in soils and materials research reported at the annual meeting of the Highway Research Board

A NEW program procedure was adopted for the annual meeting of the Highway Research Board held in Washington, D. C., Nov. 17-20. With over 400 delegates registered, the four meeting days were divided into two days of informal group discussions and two days of formal presentation and discussion of committee reports. In general, the subjects considered were the same for the formal and informal sessions and were grouped under the blanket titles of: soils investigations; transportation economics; design and maintenance; and materials and construction. Active discussion was for the most part exhausted at the informal group meetings which were mostly round-table conferences and general exchanges of ideas conversationally presented. In this account only the formal papers and reports given at the general sessions are included; these included over 30 titles and in general reached a high order of quality.

Soils investigations

Attesting the vastly increased interest of roadbuilding men in the subject, a full third of the reports and papers described soils investigations ranging from pure research in soil mechanics to factual descriptions of field procedure in specific stabilizing operations. Connected more or less closely with pure research were papers by Hans Winterkorn on physico-chemical testing of soils, the discussion of film action on soil particles by C. A. Hogentogler, a discussion on essentials of soil compaction by C. A. Hogentogler, Jr., expansion properties of soils, by H. Allen, and effects of the quality of clay on soil mortar, by R. W. Miller. All of these papers classify as documents to be considered in the study and not for lecture-room reading or condensed summary.

Dr. Winterkorn outlined progress in his continued study of the chemical and mineralogical character of soils for the purpose of arriving at a rational selection of the chemical tools (soluble salts, bitumens, etc.) to be used for stabilization. As chairman of the soils investigations committee which has the practical purpose of coordinating the work, Dr. Winterkorn stated, research work of the producer and of the user for mutual benefit has been organized in sub-projects, which are grouped around certain chemical commodities such as soluble salts and bituminous materials.

From laboratory studies C. A. Hogentogler, Jr., has arrived at determinations that indicate that dried and powdered soils should be used only for laboratory research and identification tests. For control purposes in embankment construction the soil should be tested as it comes from the borrow pit, manipulated as necessitated by the laboratory technic, with the natural moisture content gradually increased and decreased. Otherwise the densities obtained by test are likely to differ from those produced by equivalent pressures during embankment construction. This fact was reported by Frank B. Campbell, *Engineering News-Record*, Jan. 30, 1936, and by Mr. Hogentogler in the same publication March 26, 1936. Change in film characteristics may provide a reasonable explanation of a number of phenomena which have been attributed to the purely physical effects of surface tension, change in the arrangement of soil particles and the like. The data now available indicate that for soil wetted above the lubrication stage, increase or decrease in volume is due largely to film properties and not to any rearrangement of the soil particles. Likewise it is possible that free water released from adsorbed films may account largely for the drop in stability, which has been frequently observed when soils

in natural state are manipulated or remolded.

Inspired by the disclosure two years ago that soil swell was directly associated with the warping of concrete pavement, H. Allen, materials engineer, and A. W. Johnson, soils engineer, Kansas state highway department, have made extensive tests of soil swell. About 300 tests were made to determine the expansion of soil when compacted at pressures of 75, 150, 300, 600 and 1,000 lb. per sq.in. at moisture contents varying by 2 per cent increments from 10 per cent to 20 per cent. The reaction of soils of the A_2, A_4, A_6 and A_7 groups were investigated. The conclusions are that the swell varies with the size of the mold and the thickness of the specimen; that the swell of a soil is a function of the moisture content and the state of compaction, and that the amount of swell varies with the characteristics of the soils; that is, soils falling in the A_2 group display different characteristics than do those of the A_4 group, etc.

Bringing out further data on soil swell incidental to a study of the affect of the quality of clay on soil mortars, R. W. Miller, Columbia Alkali Corp., has found that there is an optimum coarse-sand content for a given binder-soil-fine-sand ratio at which greatest density is obtained, and that there is an optimum binder-soil-fine-sand ratio productive of greatest density. The optimum binder-soil content fines varies with the quality of binder soil used. It was also found that there is an optimum plasticity index that the soil fines should have, depending on the plasticity index of binder soil used. The swell tests were made to ascertain whether the soil mortars having the coarse-sand contents and plasticity indexes found to give the greatest densities were subject to undesirable volumetric changes. Soil mortars having the optimum soil-fines composition and optimum coarse-sand contents were quite free from detrimental swell. However, if the binder-soil content of the soil fines is increased, or the coarse sand is decreased, the swell becomes greater. These tests confirm the fact that a combination of high amounts of soil fines and a high plasticity index are undesirable.

Stabilization practice

A group of half a dozen papers on road foundations ranged in subject matter from geophysical processes of subsoil exploration to straight stabilizing processes with tar, with asphalt cutbacks and emulsions and with portland cement. A paper on design and operation of plants for producing stabilized soil-bound road material and another on stabilizing earth dams and roads in the national forests can also be brought within this broad classification. All of these papers described work in a development stage; that on cutback and emulsions in the use of which the Missouri highway department has gone far ahead in special mechanization of construction is to be described in an article to be published in the near future. The methods of geophysical exploration described by E. R. Shepard, research engineer, Bureau of Public Roads, were covered by the same author in an article in *ENR*, Aug. 15, 1935.

Stabilization with cement

Among the newer stabilizing materials is portland cement, experimentation with which has been carried far ahead in South Carolina. The earlier work was described by W. H. Mills, Jr., testing engineer, in *Engineering News-Record*, Nov. 28, 1935. Considering this experience, Mr. Mills decided for the more recent experiments in 1935-36 to use 6 per cent of cement in most of the field work, although 4 per cent was considered sufficient on 2,500 ft. Unknown allowances for loss in placing and mixing made it advisable to increase these percentages to 7 and 5. Adding cement in the form of a slurry was discouraged by the formation of small balls of cement. For surfacing the cement-stabilized base a temporary wearing course of 0.2 gal. per sq.yd. of 4-8 viscosity tar with an average penetration of $\frac{3}{8}$ in. was allowed to dry for 10 days, followed by an application of 0.3 gal. per sq.yd. of naphtha cutback asphalt, and 10 lb. of sand. After rolling, the road was opened to traffic, and inspection during the spring (1936) showed the surfacing in good condition, with no failures except a few cases of cracking and small pot-hole developments. Sections left unsurfaced showed the effect of traffic by shallow pot-holes and wear of the top crust.

In the opinion of those associated with the project the sheeps-foot roller is better for obtaining compaction than tractors and loaded trucks. Densities probably would have been increased had the moisture content of the mixtures been more accurately controlled at the time of compaction. Tests of cores indicated that mixing of the cement was fairly uniform throughout the samples. Average compressive strength at 86 days was 480 lb. per sq.in., the low being 350 and the high 581 lb.

Other processes described

A paper on the use of tar for stabilization, also describing experimental work in South Carolina, was presented by E. O. Rhodes, technical director, Koppers Products Co., and some part of this will be published later. A paper on plant production of soil-bound road material by L. C. Stewart, Dow Chemical Co., reviewed advantages of plant stabilization to the highway engineer and to aggregate producers; the effect of properties of available soils and aggregates on design of plant; various types of equipment for preparing binder soils and for mixing the various ingredients; chemical admixtures; specifications for plant-mixed material, and plant tests.

Treatment of soils in dams

A paper by T. W. Norcross, chief Division of Engineering, U. S. Forest Service, called for particular attention by bringing out the successful extension of stabilization processes to very small dams and cheap forest trails. While the dams are relatively large in number, the height runs from only a few feet to about 65 ft. and the storage capacity will average less than 100 acre-feet. But even though the height is small and the storage capacity little, it is of high importance to make these dams safe. To know how a soil will act when subjected to water pressure has compelled an investigation of each project. The usual laboratory tests have been conducted for determining the permeability and susceptibility of the soils to settlement under the weight of embankment. Selection of suitable soils for embankment use has been guided by the laboratory tests of grading, density, plasticity, stability and permeability under known densities. The tests include the determination under standard laboratory conditions of the Proctor relation of moisture content to density for use as a guide in the construction operations. These tests have been made by regularly organized laboratories such as the Bureau of Public Roads.

Simple field laboratories have been set up and equipped for mechanical analyses, density and moisture-content determination as established through use of the Proctor control methods. Responsibility for proper use of designated borrow pit material is placed on the field engineer, who also regulates the moisture control and rolling operations. The uniformity of borrow pit material is checked in the field laboratory and compared with the original laboratory results. Control of spreading, application of moisture and the amount of rolling, are guided by frequent tests of samples from the completed fill. Two or three samples are taken each day, giving an average of about one test for each 100 cu.yd. of fill on the smaller projects. In practically all cases it has been possible to keep the average moisture content within $1\frac{1}{2}$ per cent above or below the optimum. The density measurements indicate that the results are satisfactory for low embankments.

The experimental project of road stabilization is known as the Chimney Mountain Road of the Cherokee National Forest in northern Georgia. It is 7 miles long, and is subdivided into 36 sections each of which was given a different treatment. The combinations included variation of the size and proportions of coarse aggregate and binder soil, different admixtures and sections without admixture. There are twelve sections on which sodium chloride was

used, eleven with calcium chloride and five sections with a mixture of the two salts. Two more sections have a stabilized surface mix without admixture and the remaining six were built to Forest Service specifications for Class B gravel roads. The binder soils were obtained from the subgrade or from borrow-pits along the right-of-way. The coarse aggregate was a graded crushed stone. Insofar as possible and to facilitate visual comparison, adjacent sections were built of the same aggregate and proportions, but with different admixture conditions. Wherever sodium chloride was used, it was added integrally; calcium chloride was applied by both integral and surface treatment methods.

One half of this project was built in September and October 1935 and the rest between March and June of 1936. The 1935 sections have been through a cycle of fall rains, winter snows, spring rains and a dry summer. The only maintenance has been light blading with a motor patrol; no chemicals have been added, nor has there been any patching. It is too soon to expect conclusive results but certain weaknesses seem to be developing, some of which will undoubtedly be traced to the aggregate and binder materials.

Design and materials

Roadbuilding materials, directly in respect to quality and rather indirectly as they affect design and construction, commanded attention second only to soil investigation, and here perhaps it may best be noted that design, both as relating to the geometry of roads and the structural details of rigid pavements and other surfacing, had a minor place on the general program. The two design reports of major character were presented by Joseph Barnett, Bureau of Public Roads, and by H. J. Gilky and C. C. Ernst, Iowa State College and University of Maryland.

Based on some 900 road tests to determine safe speeds on curves Mr. Barnett concluded that on the assumption that an ample margin of safety against skidding exists when a vehicle moves around a curve at the minimum speed at which side pitch is felt, road tests indicate that vehicles may safely travel around curves at speeds which require side friction represented by factors of 0.16 up to and including a vehicle speed of 60 miles per hour with a reduction of 0.01 for each increase of speed of 5 miles per hour to counteract centrifugal force. This trend should not be accepted for speeds greater than 70 miles per hour since few tests were made at these high speeds. Some differences between individual sets of observations and the mean indicate that additional tests at all speeds would be useful. It seems advisable to design superelavation to counteract all centrifugal force, wherever possible, of vehicles traveling at about three-quarters of the asumed design speed of the highway. By this rule the sharpest curves for the assumed design speed are not affected; slower moving vehicles are aided without penalizing fast moving vehicles; possible future redesign of the highway for higher speed is not affected; and greater uniformity in design of curves results.

Professors Gilky and Ernst, reporting on 78 reconnaissance tests of the bond resistance to pulling out of high-elastic-limit steel in concrete, reached the following conclusions:

1. For both plain and deformed bars the total bond resistance is increased only slightly by added length of embedment beyond the first few inches.
2. There is some increase in bond resistance for added strength of concrete but not nearly in proportion to the increase in compressive strength.
3. For plain bars the stronger mixtures have somewhat higher residual bond strengths which results in a fairly constant percentage resistance or drag after considerable slippage has occurred (0.5 in. slip was the criterion selected for these comparisons).
4. The same is true for deformed bars but for the ¼ in. diameter bars the load did not fall off with added slip up to as much as 0.10 in. in some cases. For deformed bars the load after 0.05 in. slip was invariably at or near the ultimate attained except for the ⅜ in. deformed bars which always split the specimen before much slip occurred.
5. The 14-day specimens offered substantially the same bond resistance as did those at 28 days.
6. Greasing greatly lowered the bond resistance for the plain bars and produced earlier initial slip for the deformed bars but had little influence upon the ultimate bond resistance of the latter.
7. Removal of the mill-scale by over stressing prior to embedment seemed to have no injurious influence upon the bond resistance.
8. Some of the ¼ in. bars reached their yield point before the ultimate bond resistance was attained. None of the ⅜ in. or over-stressed bars reached a yield point stress during the test.
9. Cold-drawn wire offers much less bond resistance than does hot rolled steel. It was but slightly above that for greased plain bars.
10. Testing through springs caused a sudden heavy slippage for plain bars as the ultimate resistance was reached. The springs in no way decreased the resistance shown by deformed bars.
11. From the above it is apparent that deformed bars supply a great added margin of safety providing the body of concrete is massive enough to prevent splitting. To define safe limits of massiveness for different sizes of deformed bars, concrete mixtures and bar arrangements, constitutes one of the important problems calling for added study.

In a further report on the testing of concrete pavement joints, J. W. Kushing, research engineer, Michigan Highway Department, described an extension of the investigations outlined last year. Continuation or progress reports were also made by Prof. E. A. Finney, Michigan State College, on snow removal by tree planting, by Franz A. Aust on erosion, by H. F. Clemmer on on construction equipment and by R. R. Litehiser on brick pavement fillers.

Results of cooperative tests using the Los Angeles abrasion machine were reported by D. O. Wolf, Bureau of Public Roads. Check abrasion tests were made by eighteen cooperating laboratories on a sample of crushed limestone of uniform quality to study the effect on the test result of differences in the design and operation of Los Angeles abrasion machines. Remarkably concordant results were obtained, the mean deviation from the average for all laboratories being only 5.6 per cent.

Reporting on soundness tests by sodium and magnesium sulfates Prof. W. J. Emmons, University of Michigan, discussed the factors which influence the magnitude and uniformity of magnesium sulfate crystallization test results, showing that the test method for soundness of aggregates is not adequately defined or explored. With respect to the choice between sodium and magnesium sulfate for these tests, it is not indicated that the more consistent results are obtained with magnesium as might be expected from theoretical considerations. A summary is made of the conflicting opinions and practices which exist with respect to the criterion of failure, the extent to which correlation with service behavior has been attained, and the general reliability of the test. The committee on correlation of research in mineral aggregates is of the opinion that the test must be more thoroughly investigated if it is to serve a generally useful purpose; that the two salts, magnesium and sodium sulfates, are about equally satisfactory; that the test should not be used for purposes of rejection unless, under well defined local conditions, positive correlation with service behavior has been established; that failures of aggregates in the soundness test should be regarded as a warning, but that well-authenticated records of service behavior should be given greater consideration in determining acceptability.

Traffic and safety

Consideration of traffic and safety centered on accident prevention and traffic patterns. The papers and authors were: Progress Report on Study of Fatal Accidents, by C. F. Tilden, Professor of Engineering Mechanics, Yale University; Organizing for Safety, by Sidney J. Williams, director, public safety division, National Safety Council; Methods of Estimating Traffic Volume, by W. A. Shelton, U. S. Bureau of Public Roads; Estimating Vehicular Traffic Volume with the Aid of Traffic Patterns, by N. Cherniack, analyst, The Port of New York Authority; Initial Traffic Interference, by B. D. Greenshields, Denison University, and Research on Behavior of Motor Vehicle Drivers and Causes of Highway Accidents, by R. W. Crum.

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December 3, 1936

Better Earth Roads

RECENT FIELD experimentation as disclosed by the reports to the Highway Research Board is encouraging in its showing that few if any soils cannot be stabilized, and that several means of stabilization are available. Particle gradation is of course in most instances the essential element to create a compact soil with large inherent stability; it is supplemented variously by deliquescent salts to preserve soil moisture, by bituminous materials and by hydraulic cement, all of which are represented in successful stabilizing operations now in progress. The soils stabilized range from silts to gravel. While there remains a vast field for research in soil constitution affecting the selection and use of stabilizing agencies, field experimentation is developing a working procedure that the roadbuilder already can apply tentatively and later with more certainty. Secondary roadbuilding is rapidly being raised to standards of permanence that challenge many of our main-road standards, and soil mechanics thus is proving a boon to roadbuilding.

Still in Mind

THE SWING OF HIGHWAY RESEARCH to soils and foundations indicated in the recent deliberations of the Highway Research Board should not be misjudged. For the moment the attention of highway investigators is centered on an important new problem, but older problems are not being forgotten. The laboratories and drafting rooms of highway departments are continuing their studies of road geometry and structure as intensively as ever; soils and foundations are merely added tasks, and the fact that just now they claim much attention from investigators is due to a drive by research to meet a situation. The fact is that for the moment highway engineering is compelled to focus on soil problems because light-surfaced secondary roads form a large part of present-day road programs and because the rapidly advancing science of soil mechanics is providing new tools with which to handle foundation questions. Meanwhile, however, other and older problems still retain their place, and the work on structural design and materials is well in step with practical requirements.

A Bulwark Threatened

THE ARMY ENGINEERS are being made the goat in efforts to have work resumed on the Florida ship canal. Proponents of that canal appear to be bringing strong pressure to bear on the Corps of Engineers to send a favorable report on it to Congress. Despite two unfavorable reports, one by a special board of army engineers late in 1933 and the other by a review board named by the President in 1934, another board of army engineers recently was appointed to make a further report. This special board has found the canal justified in the public interest, and its report now goes to the board of engineers for rivers and harbors—the latter, as is well known, being a permanent board to pass on all waterway projects before they are submitted to Congress. The phrase "justified in the public interest" in the War Department's brief announcement concerning the present report suggests how it may have been possible to make the favorable finding; "public interest" is not the same as economic justification. At any rate a second step in the the campaign to bring about endorsement of the project has been completed. Possibly it is too much to expect, but it would be heartening if the older engineers who make up the Rivers and Harbors board were to stand firm on old-line principle and report a finding to the Chief of Engineers that the canal is without economic justification. Such action would serve to strengthen public confidence in the board as a bulwark against wasteful expenditures on unnecessary projects.

Corrected in Time

DEFINITE ANNOUNCEMENT OF PLANS for building the second Midtown Tunnel promises timely correction of what would probably have turned out to be a regrettable mistake—operation of two-way traffic through a long vehicle tunnel having only two lanes, and these without physical separation. In a few other tunnels traffic does operate in this way, but they are shorter and have less serious traffic difficulties to contend with. The operation of two-way traffic in the single Midtown tube, now nearing completion, would give rise to an undesirable accident hazard, it is held by careful observers, especially in the light of experience with the Holland Tunnel, and this hazard would have no compensation in the form of larger earning capacity. Since the time of the original decision to build but one tube the money market has improved greatly. There is no remaining need for PWA assistance, as the credit of the Port Authority has been so strengthened that it can now build the second tunnel on its own funds — fortunately in time to enable traffic to be separated at an early date.

Unusual Activity

WITH THE DECISION to build the second Midtown Tunnel an unusual picture of construction activity is presented. Work has recently been put under way on the East River Tunnel, and its major contracts will soon be in full swing; the first Midtown Tunnel is still under construction; meanwhile borings are being made for a further vehicle tunnel, to connect the Battery and Brooklyn. Soon three huge tunneling enterprises will be under way in the harbor waters, and a fourth one possible. To supplement this picture of tunneling activity there is also new bridge construction activity in the same territory. The Triborough Bridge has only just been completed, and the large arch at Spuyten Duyvil is in its finishing stage; yet already another structure of major size is under study, this one to cross the upper East River near Whitestone. Such concentrated activity is a sensational expression of the current demand for modernized transportation service. All of the works mentioned are designed to meet definite service needs. It is certain that other communities have corresponding needs, though perhaps not in the field of tunnels and great bridges. The accumulated deficiencies of the past half-dozen years are making themselves felt quite unmistakably and calling construction into action on a large scale to provide for them.

Pioneer Effort

NATURE'S IMPACT on human affairs during recent years has made it abundantly clear that our rivers are among the nation's principal assets. A large river, we now realize, is the mainspring of the economic life of the region through which it flows. It is for this reason that the experiment now under way in the Tennessee Valley to crystallize the new understanding into practical working form claims attention. Bitter disputes over power have hitherto obscured a clear view of what in fact is our pioneer river-development effort.

A hundred years ago rivers occupied a high position. They were the main traveled roads of the day; cities and industries clustered about them. But when the need for their transportation service declined they sank to the level of necessary evils—obstacles to free communication, useful chiefly as convenient trunk sewers. It took the reiterated lesson of flood and drought, deficient water supply and intolerable pollution to reverse this negative view. Today even the man in the street knows that when a stream is foul with pollution much of its value has been destroyed. He knows that when floodwaters are held back momentarily only to be sent on to the sea as quickly as possible they are lost to use. And he knows that building navigation dams without at the same time providing for water conservation and flood control is wasteful expenditure.

Undoubtedly a great deal of comprehensive river planning and development will be undertaken before another generation. A dozen years ago the urgent problems of the Colorado taught the value of a unified solution; Boulder Dam was the outcome. More recently the Red River in the Dakota region and various rivers in Texas have directed attention to comprehensive stream-basin planning as the basis of the security and prosperity of an entire valley. The National Resources Board set forth the same principle two years ago; it had already found legislative recognition in the Tennessee Valley Act. It is a principle of universal application.

But in not a single river valley has a comprehensive plan yet been worked out or development undertaken. The practical problems and methods of the work remain unexplored. Its engineering difficulties are known to be formidable but probably not insuperable; the difficulties of organization, finance and administration, on the other hand, are quite unknown. The Tennessee Valley work, first undertaking of the kind, affords the only information by which to appraise the nature of the job. To bring out this information is the purpose of a series of articles that begins in the present issue.

In considering the results so far obtained and the future progress of the TVA work, the mixed motives that inspired the experiment should be kept in mind. The public-power objective which was made a dominant part of the enterprise hampered the stream-development work by stirring up controversy and hostility. Further, the TVA operations throw little light on the business side of complete river development. There is no sharing in the work by the region most directly concerned—not even participation in spirit and planning, to say nothing of financing. The case up to date rests for its justification wholly on national-benefit considerations, which always are elusive and debatable.

Another matter deserves thought. In its ultimate extension river development probably cannot stop short of going to the sources—not merely to the tributary streams but to the surface runoff from the divide downward, as well as to the underground waters. This department of river development has not yet been touched upon by the TVA to any extent. Is it to be taken in hand by the national government or by local governments? The question lays stress on the problem of cooperation.

In brief, the net result of the Tennessee Valley work to date is the showing that the engineering work of comprehensive river development can be carried out, and this to remarkable valuable effect. This fact renders it certain that much of the extensive river development soon to become necessary will use and profit by TVA's pioneer effort.

It Is Not Too Late

THE OUTSTANDING CONCLUSION arising out of the deliberations of the Associated General Contractors at their fall meeting two weeks ago is that general contracting must divorce itself from traditional doctrines of isolation. The meeting threw a strong light on the changing relationship between general contractors on the one hand and subcontractors and organized labor on the other. Organized subcontractor groups and even local chapters of the association, it appears, are sitting down in agreement with labor on practices of mutual concern.

General contracting had opportunity to broaden its aims long ago. It should doubly hasten to do it now. Already it finds itself in the position of being forced to act, instead of inspiring and guiding action. Every step of public-works legislation, from the Bacon-Davis act up to the industrial coordination act that now looms up ahead, points the lesson that no agency of construction can safely continue to stand aloof.

For the moment labor relations call for first attention. But construction also has the right to look to the organized group of general contractors for that broad understanding and direct guidance which is needed in planning its important part in industrial life. The problems here are numerous; they extend deeply into such fields as finance, public-works planning, statistics, skilled-labor training, trade practices and business ethics. All the problems demand a leadership quickened by vision of the construction industry as a great whole, not as a series of separate units of contractors, labor and producers of materials.

These are responsibilities of large magnitude, and it would be unfair to expect that they can be met at once; the office of the national organization already has an immense task of detail to perform. But the demand for service to construction is imperative. The simple fact is that, as the logical coordinating force in construction, general contracting has never made its latent strength felt. It has contented itself with being just another exclusive associated-group interest, occupied chiefly with setting up keep-off-the-grass signs against other groups.

Fortunately there is still time for aggressive leadership to retrieve the losses resulting from isolation. Trained as a coordinator of trades and processes in its individual operations, it can be the mentor and leader in bringing together the diverse elements of construction into a federated industry. Today more than ever this task is laid at the door of the general contractor group.

CURRENT NEWS

Second Tube Planned For Midtown Tunnel

New York Port Authority asks bids on bonds to finance start of work on second tube of vehicle tunnel under Hudson River

The commissioners of the Port of New York Authority voted on Nov. 23 to proceed immediately with construction of the second or north tube of the Midtown Hudson vehicle tunnel from Manhattan to Weehawken, New Jersey, and announced that they would receive bids on Dec. 15 for $10,000,000 of 3 per cent general and refunding bonds to finance the initial stages of the work.

Although some of the approach structures to the Midtown Tunnel are being built to provide for twin two-lane tubes, each carrying one-way traffic, it had been intended to defer construction of the second tube for some years. The decision for immediate construction was taken, it is understood, in order to take advantage of present low interest rates.

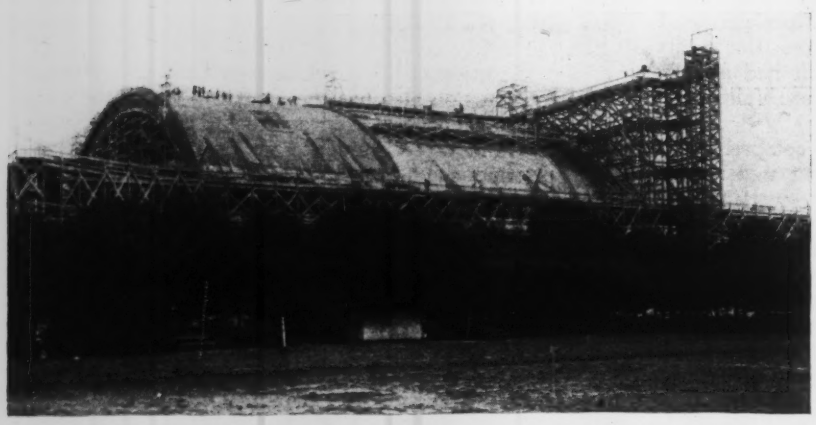
The $10,000,000 in bonds to be sold Dec. 15 will be offered for public sale on an all or none basis. They form part of an issue of $22,000,000 of general and refunding bonds, due in 1976, of which $12,000,000 will be used for refunding of various outstanding bonds carrying higher rates of interest.

The Port Authority has also advertised for bids to be opened Dec. 8 on the manufacture, storage, and delivery of 52,000 tons of cast iron and cast steel tunnel lining for the new tube. The estimated cost of the rings is about $2,640,000. At the same time authorization was voted for advertisement and acceptance of bids for driving the second tube, but no action will be taken on this matter until the bids on the tunnel lining have been received.

Authorization was given for the filing of an application with the Federal Emergency Administration of Public Works for a grant of about $9,000,000 with which to complete the New Jersey approach through Union City and into North Bergen.

Approval similarly was voted by the board to an alternative proposition authorizing the filing of an application for a $33,000,000 loan with the Federal Emergency Administration of Public Works to cover all items involved in completing the second tube and all approaches.

The south tube, which will be ready for two-way traffic operation within a year, is being financed by a Port Authority bond issue of $42,000,000 and a federal grant of $4,780,000. These figures, with the $33,000,000 which it is estimated is required to complete the second tube, indicate a total cost for the Midtown Hudson tunnel of about $80,000,000.



LARGEST CONCRETE SHELL ROOF IN THIS COUNTRY APPROACHES COMPLETION

Approaching completion at Hershey, Pa., and planned to be officially opened Dec. 19, is a sports arena that boasts the widest span concrete-shell roof yet built in this country. Of barrel type, the roof covers an area 245x356 ft. in plan, and consists of eight 220-ft. arch ribs and a self-supporting roof slab 3½ in. thick. The building is planned primarily for ice hockey, for which it will have a seating capacity of 7,200.

The 302 ft. length of roof was divided into five sections for construction purposes, and a movable falsework structure built of 300,000 bd.ft. of lumber was required. Some 250 jacks supported the roof over the falsework and permitted easy decentering.

The supporting structure and seats are also of reinforced concrete. The largest previous concrete-shell roof in the country is the 90-ft. diameter hemispherical dome of the Hayden Planetarium in New York City. The hockey arena is being built by Hershey Lumber Products, the construction organization of the Hershey Chocolate Corp. Roberts & Schaefer Co. of Chicago designed the building and is supervising the construction.

Engineers Approve Florida Canal

Army engineer board reverses findings of earlier report on a canal across northern Florida

Reversing the findings of a prior board, a special board of officers of the Corps of Engineers, U. S. Army, has submitted to the Chief of Engineers a report holding that construction of a ship canal across Florida is justified in the public interest. Details of the report have not been made public but it is understood that the new board estimates that the canal will cost, exclusive of land, about $157,600,000 in addition to the $5,400,000 already spent. The board recommends increasing the minimum canal depth from 30 to 33 ft. Cost of the canal begun last year was estimated at $143,000,000, exclusive of land.

The present report is to be made the subject of public hearings before the Board of Engineers for Rivers and Harbors beginning in Washington on Dec. 16.

Four reports

Four reports have been made on the proposed ship canal across Florida within recent years. The first report, made in December, 1933, was prepared by a board of army engineers following a long study in which many possible routes across Florida or Florida and Georgia were considered. That report found no economic justification for the construction of a canal across northern Florida but recommended that if a canal were to be built, it should be a lock canal along the route chosen for the canal begun last year. The cost was estimated at $223,000,000, exclusive of land. About the time that this board was completing its report, a board set up by the Public Works Administration made a report to the PWA that a canal could be built across Florida for $150,000,000 and that the annual benefits would justify the expenditure.

As the Public Works Administration was not authorized to put up money for projects unless they could be made self-liquidating, the President appointed a third board to review the previous reports and to advise whether the canal could be made self-liquidating by charging tolls. This board found that the possible savings through the use of the canal were so low as to warrant only a low toll charge, and that with this low toll charge the canal would not be self-liquidating.

The unfavorable report of the President's board put the canal out of the field of work to be financed by the PWA, but in the late summer of 1935 the President allocated $5,000,000 of relief funds to start work on the canal, and work was continued until early this year when Congress declined to authorize the expenditure of further funds, the relief money having been exhausted.

Traffic estimates

The whole question of whether or not the canal can be justified economically

hinges on the estimates of traffic passing through the canal. Oil is the principal commodity that would be handled through the canal, and the first board of army engineers to report on the project assumed that the oil traffic would decrease with the depletion of the oil reserves tributary to the Gulf. The President's special board took a more optimistic view of the oil traffic but found that to make the canal pay would require much more oil traffic than even the most optimistic estimates predicted.

Few details of the earlier report have ever made public and none of the most recent report, but it is believed that an increase in coastwise traffic moving around Florida between the Gulf and the Atlantic seaboard has resulted in higher figures for potential traffic used by the new board.

Water supply

When construction of a sea level canal across northern Florida was proposed in 1934, strong objection to it was raised by interests in southern Florida on the ground that the canal would be injurious to the vast underground water supplies of the state. As a result of this agitation, after the army engineers had been assigned the task of building the canal, a board of engineers and geologists was appointed to study the question of water supply. It reported that the effect of the canal would be purely local and that even the local effect could be minimized by remedial work. It is understood that the new report accepts this conclusion and includes the cost of remedial work in its estimates.

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Toyko Will Extend Subway

EXTENSION OF THE TOKYO SUBWAY from Shimbashi west to Shinagaya, a distance of about three miles, is expected to get under way next spring, with completion of the work in the spring of 1938. The work will be done for the Tokyo Subway Co. by the recently organized Keihin Subway Company.

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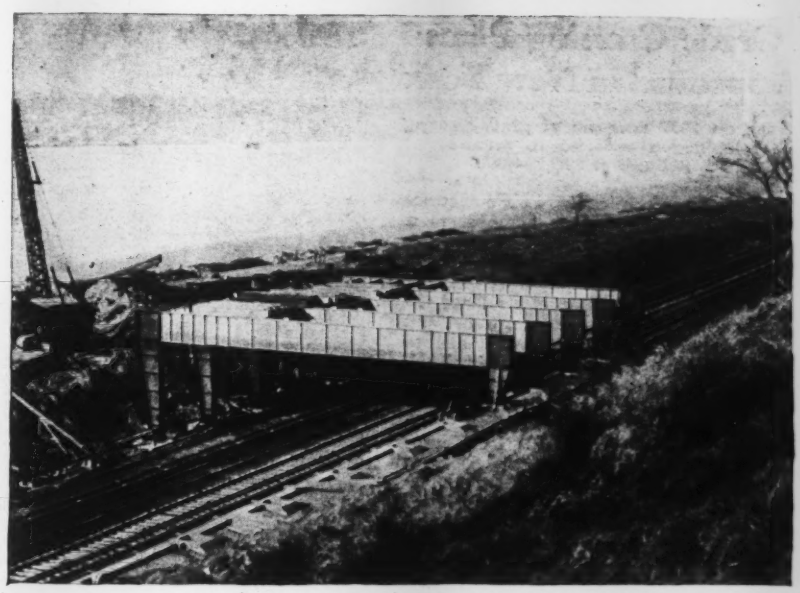
Modernized Elevated Highway Opened at Kansas City

The Inter-City Viaduct, 1½-mile trafficway built after the 1903 flood to provide a high level connection between Kansas City, Kan., and Kansas City, Mo., was re-opened to traffic on Nov. 20, after having been closed for nine months while a modern four-lane concrete roadway was substituted for its old and inadequate two-lane roadway. Widening of the roadway was made possible by the removal of two street car tracks located along one side of the structure. Cost of reconstruction, $1,063,000.

Originally built as a toll structure at a cost of 2¼ million dollars, the Inter-City Viaduct was opened to traffic in 1907. It proved to be a commercial failure, and in 1918 it was purchased by the two cities for 1¾ million dollars. The original design provided for a live load that included heavy interurban cars, and consequently the foundations, steel bents, and floorbeams were found to be adequate to carry the new widened roadway without change. New stringers and cross joists, however, had to be installed.

The widening is the second improvement to be undertaken since the cities purchased the viaduct. Several years ago a lower deck was completed across the Kaw River, to connect with the riverfront industrial section. Slow truck traffic is confined to this lower roadway while the new upper deck roadway is reserved for vehicles traveling not less than 30 nor more than 40 miles an hour. The reconstruction work was designed and supervised by Ash, Howard, Needles & Tammen, Kansas City.



NOVEL STRUCTURE TO COVER TRACKS IN NEW YORK RIVERSIDE PARK

BURYING the tracks of the New York Central Railroad throughout the length of Riverside Park along the Hudson River waterfront is one of the largest construction operations under way in New York City. Work is going on between 72d and 121st Sts., and last week steel erection began on one of the most unusual of the enclosure structures—steel rigid frame bents which will be sheathed in concrete slabs and walls. This structure will be buried in new fill, placing the railroad in tunnel and providing a park area that is uninterrupted between Riverside Drive and the new parkway being built along the river bank.

Contracts for the rigid frame type of structure have been let for the section between 121st St. and 98th St. The bents have a clear span of 66 ft. and are placed on 17 ft. centers along the track. The above view shows the first four bents erected at the 121st St. end of the work. A traveler, to be set up on this steel, will move south erecting the bents and floor steel.

Below 98th St., the enclosure structure consists of continuous retaining walls on each side of the track, with steel girders spanning between. As compared with this type of design, the rigid frame structure exerts much smaller loads on the foundation, a desirable feature in the locations in which it is used.

The work is being done by the New York City Parks Department and the New York Central Railroad, Madigan-Hyland, designing, supervising engineers.

Spokane Orders Big Pumps

Two turbine pumps which are among the largest of that type in the world will go into operation in Spokane, Wash., next July. Contract for furnishing the pumps has been awarded to the Pomona Pump Co. of Pomona, Calif., for $28,488. The 900-hp. pumps, each weighing 30,000 lb., will deliver 7,000 gal. of water each per minute against a total head of 424 ft. They will be installed in the Ray St. wells now being drilled by the City Water Department.

Specifications for the pumps were drawn by Alexander Lindsay, Spokane City Water Superintendent.

Planning Officials Discuss Master Plans

Most prominent subject on the program of the Conference on City Planning, sponsored by the American Society of Planning Officials in Chicago on November 19 and 20, was that of the definition and financing of the master plan for a city. The master plan, it was brought out, is a plan for control of complete community development, not of one aspect of it alone, such as public buildings or roads and streets. It was agreed that the program of an adequate master plan should entail land-use studies, thoroughfare and traffic plans, housing studies and replanning of lighting areas, real estate subdivision regulation, and adequate provision for recreation as well.

There was some disagreement at the conference as to whether sound planning presupposed a pay-as-you-go policy, or whether a sound program of bond issues might not, it was contended, be equally permissible.

Grade Crossing Plans Approved in New York

Work on 1937 program of grade-crossing elimination expected to require expenditure of $18,714,000

The New York State Public Service Commission has given its approval to a list of 24 grade crossing elimination projects to be undertaken in 1937 involving an estimated total expenditure of about $18,714,000. Of the 24 projects listed, 15 were on the 1936 list but were not put under construction due to delays and to objections made by the railroads involved. The nine new projects involve a total of only $344,000. It is expected that further hearings will be held on most of the 1936 projects carried over into 1937, thus possibly subjecting several of them to further delay.

The largest of the projects, to cost more than $8,000,000, is in the village of Saratoga Springs and calls for a relocation of several miles of the Delaware & Hudson double-track lines in Saratoga Springs and in the village of Ballston Spa. This project has been pending for several years and is held up, it is understood, chiefly by opposition from the village arising from the anticipated loss in tax revenue from the railroad if the relocation is effected. In this instance the railroad is anxious to proceed with the work as ordered by the commission.

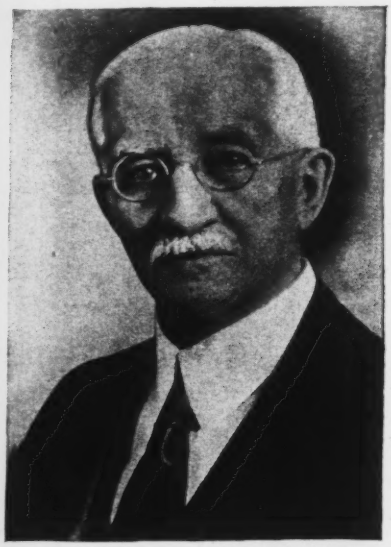
Two projects in Nassau county for the elimination of Long Island railroad crossings in Hempstead, Freeport, and Garden City are estimated to cost $7,850,000.

The $18,000,000 of projects include only those eliminations which are to be performed through the use of bond money authorized by the $300,000,000 bond issue for grade crossing work voted on ten years ago. Under that authorization, 50 per cent of the cost is paid by the railroad companies affected, 49 per cent by the state, and the remaining 1 per cent by the county in which the work is located. This work is entirely separate from any grade crossing work which may be undertaken with possible future federal funds. It is also separate from the considerable amount of grade crossing work which has been handled during the past three years directly by the state department of public works with the aid of federal grants; this work has gone forward faster than that under the bond issue since the federal grant projects have not been subjected to the delays and litigation which arise in cases where the railroads pay part of the cost.

It is expected that about $3,500,000 in grade crossing contracts will be awarded by the Department of Public Works to be financed entirely out of federal funds for 1937.

Construction League Nominates Officers

At a meeting of the Policy Committee of the Construction League, held in Washington, D. C., Nov. 18, the nomination was voted of William Stanley Parker, of Boston, and Carlton S. Proctor, of New York, for the office of general chairman and first vice-chairman respectively. Mr. John H. Zink, of Baltimore, was renominated for general secretary. Following an executive session which considered finances and administration policies general discussion was had of matters to be taken under consideration by the League at its coming general meeting. A statement was made by W. A. Klinger, president of the Associated General Contractors, of the attitude of a contracting business toward possible legislation restoring NRA policies. Mr. Sullivan W. Jones, assistant coordinator for Industrial Cooperation, reported in general terms the objectives of the conference on industrial cooperation to be held in Washington in December. It was voted to send observers to the conference without authority to act for the league. An extensive list of subjects to be considered by the Construction League was presented by a special committee. In considering the committee's report the announcement was made that the finances and organization of the League did not permit of developing these various projects for some time. It was voted that they be recorded for future consideration when conditions made it possible to consider definite action.



Wide World Photo

PRIZE WINNER

ARTHUR N. TALBOT, to whom the John Fritz Medal is to be awarded in January, as noted in these pages last week, will be the seventh civil engineer to receive this award in the 32 years since it was first established. Since 1905, when it was awarded to Lord Kelvin, the medal has been given to 31 persons, no award being made in 1913. Those civil engineers who have received it are: Alfred Noble, 1910; J. Waldo Smith, 1918; George W. Goethals, 1919; John F. Stevens, 1925; Ralph Modjeski, 1930; and John Ripley Freeman, 1934.

Other outstanding recipients of the award include George Westinghouse, Alexander Bell, Thomas Edison, Orville Wright, Guglielmo Marconi, and Herbert Hoover.

Metropolitan Water District Sued Over Tunnel Contract

A suit for $838,586 in damages has been brought against the Metropolitan Water District of Southern California by the Dravo Contracting Co. of Pittsburgh, contractor on the 7.2-mile Valverde tunnel of the Colorado River Aqueduct. The tunnel was completed in October. At that time the contractor filed a claim for $88,565 for extra work in an enlarged section through heavy ground in which it was necessary to remove steel and to replace steel supports that collapsed, and a claim for $750,000 as representing an amount by which the firm would have increased its bid had the true ground conditions been revealed to it.

The two claims are covered in the present suit, in which the contractor claims misrepresentation and concealment on the part of the district with reference to underground conditions.

Officials of the district state in answer to a request from *Engineering News-Record* that in their opinion no ground exists by the claim of misrepresentation as the contractor examined the ground and inspected the cores of all drill holes along the tunnel line. They point out that under the specifications the contractor takes full responsibility for all ground conditions. The contractor's bid included unit prices for placing tunnel supports where required and for tunnel lining. No statement was made by the Dravo Contracting Co. as to its position.

Contract Let for One Shaft For Queens Tunnel at New York

Contract for the excavation of the Manhattan ventilating shaft for the $58,000,000 vehicle tunnel under the East River from Queens to Manhattan, New York City, has been awarded to the Treist Construction Co. of New York by the New York City Tunnel Authority. Of the eleven bids received, the Triest Company's bid of $329,216 was low. The other ten bids ranged from $335,600 to $505,200.

The specifications call for construction of a concrete-lined 60 x 112 ft. shaft 105 ft. deep. The shaft will be located at 42d St. between First Ave. and the river front.

EXPLORATORY BORINGS for the East River vehicular tunnel from Manhattan to Queens, New York City, indicate that several types of ground condition will be met. On the Manhattan side, the tubes will start through Manhattan schist, emerging from the rock just outside the Manhattan shore line; they will then be driven through the clay and gravel bed of the river, coming so close to the river bottom that it will be necessary to blanket them with clay. Just east of this deep section of the river, the tubes will pass through a wall of rock which is a continuation of the Fordham gneiss intrusion which forms Welfare Island and the other East River islands. The borings indicate that the tubes, emerging from this rock formation, will again pass through the river bed, scrape the top of another subterranian rock formation and finally pass through the rock structure of the Queens shore line. The Tunnel Authority announces that satisfactory progress is being made on the Queens shaft, now under construction.

Robert Rees Dies

Robert Irwin Rees, who was to have retired on Dec. 1 from his position as vice-president of the American Telephone & Telegraph Co. to become full-time vice-chairman of the Engineers Council for Professional Development (*ENR*, Nov. 12, 1936, p. 697), died in Detroit on Nov. 23 at the age of 65. General Rees was a graduate of the Michigan College of Mining and Technology and later attended Harvard University and the New York Law School. Upon completion of his schooling he decided upon a military career, enlisted in the engineer corps, and in 1899 was commissioned second lieutenant. He served through the Spanish American war and the Philippine insurrection and in 1918 was assigned to General Pershing's staff, with the rank of brigadier-general, in charge of all educational work of the A.E.F.

General Rees resigned from the army in 1924 to become assistant vice-president of the American Telephone & Telegraph Co., which position he held until his death.

General Rees had been active in the work of the Engineers Council for Professional Development ever since its inception, representing the Society for the Promotion of Engineering Education. Since the foundation of that society he had been chairman of the committee on professional training. He also served as chairman of the ways and means committee.

All-American Canal Receives Allotment for Power Plant

Allotment by the Public Works Administration of a grant of $1,242,000 and a loan of $1,518,000 to the Imperial Irrigation District makes possible the construction of the first power unit on the All-American canal. The plant will be built by the district at site No. 4, where there is an available head of 47 ft. The ultimate installed capacity will be 18,500 kw., one-half of which will be constructed at this time. In addition, the project contemplates increasing the capacity at the irrigation district diesel-electric plant at Brawley, Calif., from 2,250 kw. to 7,250 kw. for use as a standby plant. Power lines serving the principal urban and rural districts of the Imperial Valley will be constructed.

The above information was inadvertently omitted from the news item relating to the district in last week's issue (ENR, Nov. 26, 1936, p. 765).

U.S.S.R. Completes Second Trans-Siberian Railway

Completion two years ahead of schedule of a 2,000-mi. railway line across Siberia was announced on November 27 at the Congress of Soviets in Moscow. The new line, which is understood to be double track, branches north from the old Trans-Siberian Railroad at Taishet, about 500 miles west of Lake Baikal and runs north of that lake across Siberia to Konsomolsk, about 125 miles north of the Manchukuoan Border. At that point the line divides into three branches, one running north to Nikolai on the Pacific, one east to a new port on the Sea of Japan, now being built, and one south to Kahbarovsk, the point at which the old Trans-Siberian swings south toward Vladivostok.

Research Body Organized At Ohio State

More than 200 industrialists and members of the faculty of Ohio State University met on Nov. 6 and 7 at the University, in Columbus, Ohio, to discuss the objectives and program of the newly incorporated Ohio State University Research Corporation, a joint enterprise of the University and of Ohio industries to foster systematic research in applied science.

The first day of the meeting was devoted to registration and to an inspection of the research facilities and activities of the University. A dinner meeting in the evening was presided over by George W. Rightmire, president of the University.

At the concluding session, on the morning of Nov. 7, David Ross and H. F. Meikle, of the Purdue Research Foundation, described experience at Purdue University with similar industrial research.

The incorporators of the new foundation are: Charles F. Kettering, president of General Motors Research Corporation; James R. Lincoln, president of the Lincoln Electric Co.; Charles T. MacQuigg, engineer and manager of the Union Carbide & Carbon Research Laboratories; Julius F. Stone, chairman of the board of trustees of Ohio University; and Charles F. Michael, president of the Ohio Locomotive Crane Co. and of the Ohio Manufacturers Association. Hurlbut S. Jacoby is director of industrial research at Ohio State University

SOCIETY CALENDAR

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, San Francisco, Calif., December 7-10.

AMERICAN SHORE AND BEACH PRESERVATION ASSOCIATION, annual meeting, Washington, D. C., Dec. 14.

AMERICAN ROAD BUILDERS ASSOCIATION, convention and highway exhibit, New Orleans, La., Jan. 11-15.

UNIVERSITY OF COLORADO, highway engineering conference, Boulder, Colo., Jan. 14-15.

AMERICAN ENGINEERING COUNCIL, annual assembly, Washington, D. C., Jan. 14-16.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York City, Jan. 20-23.

ASSOCIATION OF WESTERN STATE ENGINEERS, annual meeting, Santa Fe, N. M., Dec. 3-5.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, MIDDLE ATLANTIC SECTION, fall meeting, New York City, Dec. 5.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, annual meeting, New York City, Jan. 21-23.

AMERICAN WOOD PRESERVERS ASSOCIATION, annual meeting, New Orleans, La., Jan. 26-28.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Detroit, Mich., Jan. 1-29.

LICENSE EXAMINATIONS

MICHIGAN, examination for architects will be held at the University of Michigan and for engineers and surveyors at the University of Michigan at Michigan State College, at Michigan College of Mines, and at Ironwood, on Dec. 28-30.

Personals

SIDNEY T. BENSON has resigned his position as engineer for the village of Falconer, N. Y.

F. L. HAGAN has been appointed county engineer on WPA projects of Hardin County, Ky.

LOUIS P. TESSIER has been appointed inspector of industrial and public buildings for the province of Quebec.

CAPT. H. TWICHELL has been appointed assistant to the United States district engineer at Kansas City, Mo.

SIDNEY BUCHER has resigned his position as resident engineer in Wayne county for the Ohio State highway department.

O. R. TOMAN and E. E. CHILBERG, consulting engineers of Lincoln, Neb., have organized the Midwestern Engineering Co., with headquarters at that city.

ARTHUR T. CLARK has resigned his position as superintendent and engineer of the department of water, Morristown, N. J., to become associated with the Barrett Co. of New York City.

BYRAM W. STEELE, chief designing engineer of the Tenessee Valley Authority, resigned Nov. 14. Mr. Steele has not announced his future plans. He came to the TVA last spring from the U. S. Reclamation Service's main office at Denver where he was engineer in charge of design of all dams built by the Interior Department. Mr. Steele was in charge of the structural design of Boulder Dam and helped design many other dams during the 16 years he was with the Reclamation Service.

Obituaries

SETH PERKINS, JR., chief engineer in the Miami district for the WPA, died in Miami, Fla., on Nov. 11, at the age of 49.

CHARLES P. WATKINS, 81, a retired construction engineer, died on Nov. 17 in Louisville, Ky.

G. HERBERT HAVERSTOCK, a bridge engineer for the Chesapeake & Ohio Railroad, died on Nov. 22 in Richmond, Va., at the age of 43.

HERMAN S. MARTIN, traveling engineer inspector for the WPA, with headquarters in San Francisco, was killed in an automobile accident on Nov. 12 at Ely, Nev.

JOHN C. BALCOMB, a member of the engineering staff of the New York Worlds Fair Corporation, died in New York City on Nov. 26, at the age of 58. For the past 10 years, Mr. Balcomb had been engaged in power house construction in the East and Middle West and on hydro-electric work in Nebraska.

ALBERT T. PERKINS, consulting engineer and railroad adviser to the Union Trust Co. of St. Louis since 1908 and executive officer, engineer, or president of various railways, including the St. Louis, Brownsville, & Mexico; New Iberia & Northern, Chicago, Milwaukee & Gary; and Apalac-

hicola Northern, died in St. Louis on Nov. 23 at the age of 71. Mr. Perkins graduated from Harvard University in 1887 and went to work for the Chicago, Burlington & Quincy R.R. He left that company in 1906 while serving as superintendent of the St. Joseph Division to become consulting engineer and to the St. Louis Municipal Bridge & Terminal Commission.

WALTER E. SULLIVAN, who had been practicing as a consulting engineer since his retirement in 1932 from his position as chief engineer in charge of sewers for the city of Cincinnati, died in Cincinnati at the age of 66 on Nov. 24.

WILLIAM A. JONES, city manager and, before its incorporation as a city, village manager of Huntington Wood, Mich., since 1926, died in that city on Nov. 10 at the age of 51. Mr. Jones graduated in civil engineering from Syracuse University in 1910 and after working on railroad and water system construction, became engineer for the Detroit board of water supply in 1920, a position he held for six years.

FRANK P. MCKIBBEN, died at his home in Black Gap, Pa., on Nov. 27 at the age of 65. During the past ten years Mr. McKibben designed many of the larger arc-welded bridges buildings in this country in his capacity as consulting engineer for the General Electric Co. Before taking this position Mr. McKibben was active in the teaching of civil engineering. After graduation from Massachusetts Institute of Technology in 1894 he served at that school as instructor, assistant professor, and associate professor in the department of civil engineering. In 1907 he became head of the department of civil engineering at Lehigh University and in 1919 took a similar position at Union College. In 1924 he added to his duties at Union College those of city engineer for the city of Schenectady, N. Y. In 1925 he resigned both positions to practice as consultant for General Electric Co.

CONSTRUCTION STATISTICS FOR THE WEEK

ENGINEERING construction awards this week reached the second highest weekly volume this year, $74,328,000. This high total is due to the highest private awards for any week in more than four years, $38,517,000. Public volume is $35,811,000, of which federal is $6,325,000 and state and municipal, $29,486,000. Corresponding values for a year ago are: total, $49,345,000; private, $11,577,000; public, $37,768,000; federal, $4,941,000; state and municipal, $32,827,000.

The high private volume is due to heavy awards both for industrial buildings and unclassified projects. Public buildings are also higher this week as are highways and waterworks. The classified sub-totals are: industrial buildings, $22,458,000; commercial buildings, $3,895,000; public buildings, $12,644,000; highways, $9,647,000; bridges, $5,941,000; sewerage, $1,296,000; waterworks, $1,955,000; earthwork, drainage, $2,173,000; unclassified, $14,319,000.

The larger projects for the week include: rayon plant, Wilbert J. Carter, Greensboro, N. Car., $750,000; strip mill, Republic Steel Co., Cleveland, Ohio, $15,000,000; blast furnace, Inland Steel Co., Indiana Harbor, Ind., $2,500,000; State House, Salem, Ore., $2,006,000; completing interior of museum and constructing lagoon wall, Rosenwald Museum of Science and Industry, Chicago, Ill., $3,147,000; high school, Menasha, Wis., $535,000; Brand Whitlock Homes Project, Toledo, Ohio, $1,284,000; superstructure, Jane Adams Housing Project addition, Chicago, Ill., $2,224,000; highways, Mississippi, $1,517,000; Georgia, $2,319,000; New York, $854,000; Pennsylvania, $914,000; bridges, New York, $1,092,000; Masachusetts, WPA labor, $726,000; water filtration plant, St. Louis County Water Co., Hine, Mo., $729,000; Fresno Dam on Milk River, Bureau of Reclamation, Montana, $981,000; 100,000 tons steel rails, Pennsylvania Railroad, Philadelphia, Pa., $4,000,000 (est.); 82,150 tons steel rails and track fittings, New York Central Railroad, New York, N. Y., $5,500,000 (est.); 35,000 tons steel rails, Chicago, Rock Island and Pacific RR., Chicago, Ill., $1,275,000.

New capital is made up of PWA allotments, $14,826,000; state and municipal bond sales, $4,335,000 and corporate security issues, $9,510,000; a total of $28,671,000.

CONTRACTS
(Thousands of Dollars)

	Weekly Average 1935	Prev. 4 Weeks	Week Dec. 3 1936
Federal Government	$14,735	$5,044	$6,325
State and Municipal	37,038	20,776	29,486
Total public	$51,773	$25,820	$35,811
Total private	7,103	14,866	38,517
Week's total	$58,876	$40,686	$74,328
Cumulative to date:			
1935..$1,403,990,000	1936..$2,194,872,000		

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

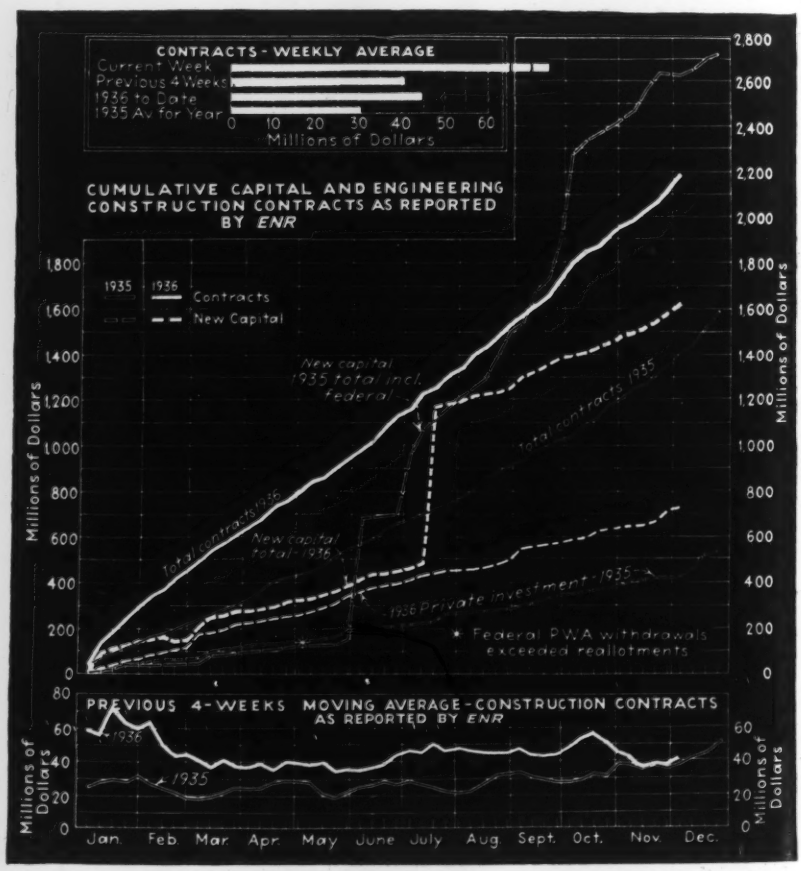
1936	Week Dec. 3	Cumulative
State and municipal	$4,335	$484,110
PWA non-federal	14,826	168,699
RFC loans	.....	26,663
Corporate issues	9,510	243,502
PWA loans, Private	.....	—1,665*
Total Non-Federal	$28,671	$921,309
Federal	.....	691,237
Federal	.....	.....
Total new capital	$28,671	$1,612,546
Cumulative to date:		
1935..$2,635,437,000	1936..$1,612,546,000	

* Bond sales in this classification exceed reallotments during current year.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for self liquidating" projects, and 25 per cent of WPA construction appropriations.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Dec., 1936	220.67	106.07	Nov., 1936	159	70
Nov., 1936	212.70	101.67	Oct., 1936	178	78
Dec., 1935	194.90	93.69	Nov., 1935	171	75
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47



Construction Equipment and Materials

Vibrator for Concrete Pavement

A device to permit internal vibration of concrete in pavement construction has been developed by the Electric Tamper and Equipment Co. of Ludington, Mich. The unit, known as the Jackson Paving Tube, may be attached to any type of finishing machine directly in front of the reciprocating screed. It consists of a 4-in. steel pipe, spanning the width of the pavement to within 3 in. of the side forms, upon which is mounted an electric vibratory motor powered by a portable gas-electric generating unit mounted on the finishing machine. A lever is provided to raise and lower the tube.

The vibratory tube works within the roll of concrete carried by the screed and, the manufacturers claim, does a complete puddling and compacting job, working so close to the transverse joints and side forms as to require no additional puddling devices. The use of this machine is said to permit the use of a very dry mix; thus, it is said to be possible to handle a 1-in. slump concrete and still leave a plastic material for the finisher.

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Leipzig Trade Fair Held in February

The Leipzig Trade Fair will be held from Feb. 28, to March 8, 1937, inclusive. The spring fair will be the 1,977th session of this Fair, covering a period of over 700 years.

General recovery of international trade is apparently indicated this year by an assured attendance of 200,000 exhibitors and buyers from 74 companies. The fair will comprise over 8,000 exhibits of the industrial and art products of 24 of the leading producing countries.

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New Equipment in Brief

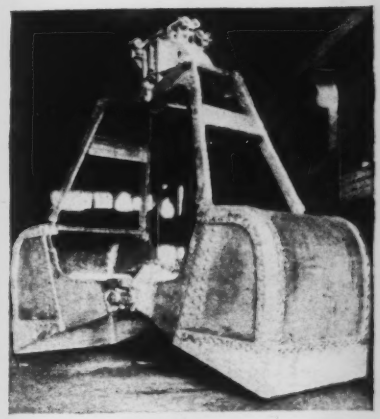
Excavator—The new 1 yd. excavator just announced by the Harnischfeger Corp. of Milwaukee, is said to be the first excavator of this size to be equipped with tractor crawlers. The weight of the new model has been greatly reduced by the use of high tensile steels and electric welding.

Glass tile—The U. S. Glass Tile Co. of Chicago, Ill., has developed a new method of applying structural glass tile. A sheet of glass coated with a specially prepared mastic is held in place by a metal binder, folding over the slightly beveled edge of the glass but not projecting over the face of the glass. This binder is embedded in reinforced concrete, thus forming a solid load-bearing block. It is said that in this type of glass tile construction all stress is confined to the concrete backing, leaving the glass surface free for expansion or contraction and reducing breakage or cracking to a minimum. Should breakage occur, individual tile can easily be replaced.

Publication of House Organ Marks Centennary

The Baldwin-Southwark Corp. of Philadelphia devotes Vol. 1, No. 1 of their new quarterly house organ, *Baldwin-Southwark*, to a centennary issue marking the hundredth anniversary of the founding of the company.

The 28-page publication includes a brief biography of Samuel Merrick, founder of the company; histories of the three companies which have been merged to form Baldwin-Southwark, the Southwark Co., DeLaVergne Refrigerating Co., and the I. P. Morris Co.; and a history of the Pelton Water Wheel Co., associated with Baldwin-Southwark as a subsidiary of the Baldwin Locomotive Works.



BIG BUCKET

This coal bucket, the largest ever built the makers say, will take 12 tons of coal at a bite. The bucket weighs 23,000 lb., stands 18 ft. high overall, and has a jaw spread of 19 ft. It was manufactured for the Pittsburgh Coal Co. by the Hayward Co.

Manufacturers' Activities

✦ BRODERICK & BASCOM ROPE Co. has opened a branch office and warehouse in Chicago.

✦ A New England office has recently been opened in Boston by the LEEDS & NORTHRUP Co. to handle their complete line of instruments.

✦ The LINDE AIR PRODUCTS Co. of New York City has opened a new district office in Charleston, W. Va. A. R. O'Neal has been appointed district manager.

✦ ABBOT A. HANKS, INC., San Francisco, Calif., has just celebrated its 70th anniversary. The firm, which was founded by the father of the present president, specializes in inspections, in the testing of cement, aggregates, steel and building materials and in the assay and analysis of metal products and ores.

Distributor Appointments

✦ Appointment has been announced of Industrial Supply Co. as the Salt Lake City distributor for the LINCOLN ELECTRIC Co. of Cleveland, Ohio.

✦ H. B. Fuller Equipment Co. has been appointed as agent in the Cleveland territory for the EASTON CAR & CONSTRUCTION Co. of Easton, Pa.

✦ The KOEHRING Co. of Milwaukee, Wis. has recently appointed three new distributors. The Arizona Lumber Co. of Phoenix will handle Koehring products in Arizona. The Dallas territory is to be handled by the Leland Equipment Co. of Dallas, Texas. The Roanoke Tractor & Equipment Co. of Roanoke, Va. will serve the Virginia territory.

✦ GAR WOOD INDUSTRIES, INC. recently announced appointment of the following distributors: Shaw Sales Co., Billings, Mont.; A Fassnacht & Sons, Chattanooga, Tenn.; Baker Equipment Engineering Co., Charlotte, N. C.; Lone Star Equipment Co., El Paso, Texas; Mississippi Truck & Signal Co., Jackson, Miss.; C. W. Rathbun Co., Oklahoma City, Okla.; Allison Steel Manufacturers Co., Phoenix, Ariz.; Phelps Auto Car Co., Salt Lake City, Utah; Union Iron Works, Spokane, Wash. These distributors will handle products of the hoist and body division of Gar Wood Industries.

Personnel Changes

✦ A. R. Ellis has become president of the PITTSBURG TESTING LABORATORY.

✦ E. C. Swann has joined the New York office staff of NATIONAL GUNITE CONTRACTING Co.

✦ Earl E. Stearns has been appointed sales manager of the BARBER-GREENE Co. of Aurora, Ill.

✦ The KENNEDY VALVE MFG. Co. of Elmira, N. Y. have appointed Leonard E. Shaffer Pacific Coast manager.

✦ The EMSCO DERRICK & EQUIPMENT Co. have appointed Richard A. Wheeler sales manager of their tractor equipment division.

✦ The street lighting department of the HOLOPHANE Co., of New York City, has been put under the managership of Stuart R. Williams.

✦ INLAND STEEL Co. of Chicago has appointed Wallace W. Smith as assistant vice-president in charge of the sale of structural shapes, plates, and tiling.

✦ Frank Cordes, formerly senior vice-president, has been elected president of the BLAW-KNOX Co., of Pittsburgh, to fill the vacancy caused by the death of Mr. Irvin F. Lehman.

✦ Everett Chapman has been appointed president and Robert J. Whiting vice-president of Lukenweld, Inc., a division of LUKENS STEEL Co. of Coatesville, Pa.

✦ Recent appointments by the RIVERSIDE CEMENT Co. include Warren H. Leonard, to the office of general manager; John E. Allen, to the office of sales manager; Holton C. Dickson, to the office of assistant sales manager.

BUSINESS SIDE OF CONSTRUCTION

November 5 Per Cent Over 1935 ENR Cost Index Rises to 220.67

ENGINEERING construction for November totalled $162,743,000 compared with $154,973,000 a year ago, a 5 per cent gain. The drive a year ago to get PWA work under contract swelled the public works volume and with it the total volume in November and December to the high months for the year which is contrary to the usual seasonal trend. No such artificial influence is present this year. The public work is lower than last year's accelerated volume while private construction shows substantial gains. The volume sub-totals are, for 1936: private, $59,462,000; public, $103,281,000; federal, $20,177,000. For 1935, corresponding values are: private, $24,301,000; public, $130,672,000; federal, $15,187,000.

The volume index for November is 159 compared with 171 a year ago. The sharp rise in construction costs is responsible for the lower volume index. This means that while dollar volume is gaining, the physical volume it represents is below a year ago for November.

Industrial building awards recorded the highest monthly average since May 1930, while highways, public buildings and commercial building activity dropped below last month. Both industrial and commercial buildings gained substantially over last year, 272 and 62 per cent respectively. November last year was the only month that went over $10,000,000 in highway awards while five months this year have exceeded this figure.

New England awards dropped to 50 per cent of last month and below last year. South and West of Mississippi dropped below last month and last year, Far West with practically the same volume as last month dropped below last year. Middle West, below last month's volume, exceeded last November's and Middle Atlantic gained over both last month and last year.

New Capital

PWA allotments netted an increase of $29,782,000 in new capital for October while state and municipal bond sales totalled $50,837,000 and corporate security issue sales, $23,854,000 for the month.

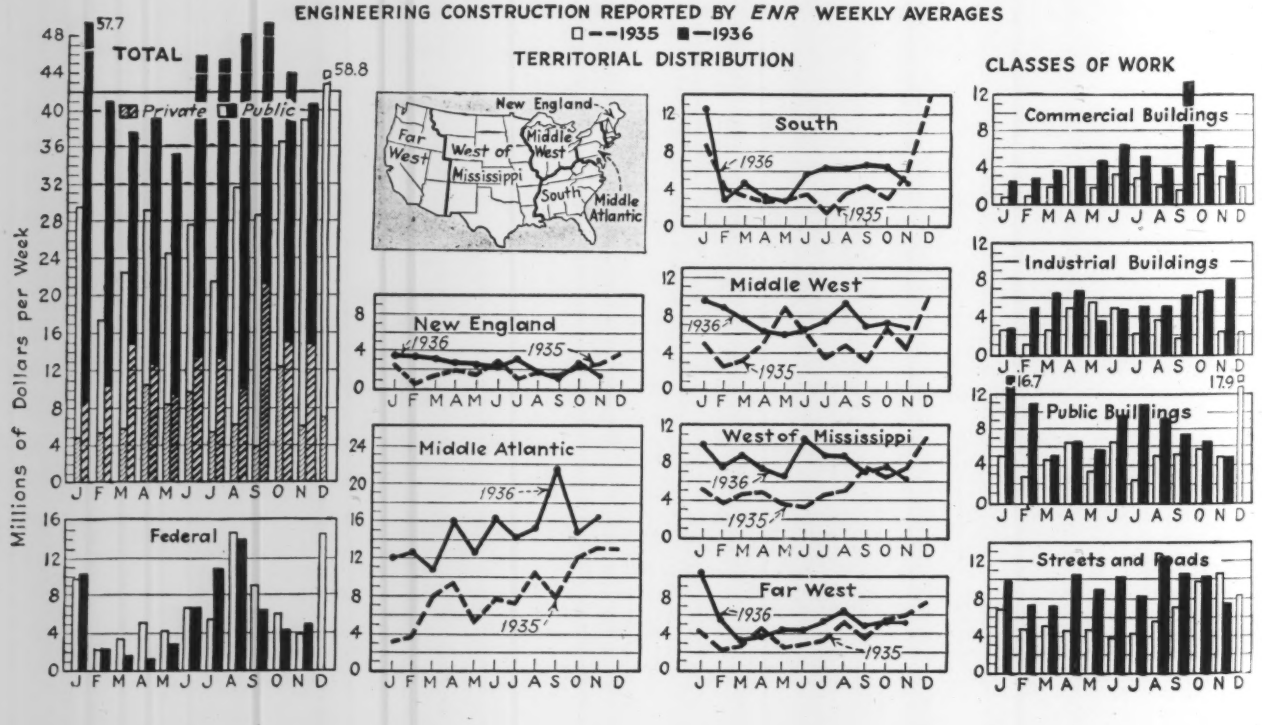
Materials

Portland Cement—Production for October is reported at 12,470,000 bbl. by U. S. Bureau of Mines, shipments, 13,080,000 bbl., stocks, 18,119,000 bbl. Production and

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN NOVEMBER, 1936

Four Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States November 1936	United States Eleven Months 1936	United States Eleven Months 1935	Canada November 1936
Waterworks	57	850	64	195	718	1,760	**3,644**	85,378	66,202	56
Sewerage	121	2,959	1,073	4,277	1,284	435	**10,149**	113,144	83,681	56
Bridges, public	1,555	2,084	1,960	2,417	2,342	939	**11,297**	157,271	69,783	825
Earthwork and waterways	19	2,546	1,653	154	3,535	1,376	**9,283**	164,929	210,417	1,104
Streets and roads	1,774	9,167	3,511	5,535	7,488	3,073	**30,548**	450,906	292,201	960
Buildings, public	702	3,188	1,512	6,810	4,845	2,528	**19,585**	410,061	226,261	451
Unclassified, public	15	15,833	1,010	646	308	963	**18,775**	113,847	63,374	2,766
Total public	4,243	36,627	10,783	20,034	20,520	11,074	**103,281**	1,495,536	1,011,919	6,278
Federal government (included in above classifications)	126	4,258	2,575	4,611	6,180	2,427	**20,177**	295,693	303,324	.....
Private										
Bridges, private	.....	550	.....	.....	23	.....	**573**	11,714	10,957	.....
Buildings, industrial	765	11,986	5,731	3,976	2,755	6,600	**31,813**	259,847	163,565	4,062
Buildings, commercial	390	15,860	450	1,160	.....	300	**18,160**	246,495	103,687	453
Unclassified, private	53	316	1,258	2,077	1,672	3,510	**8,916**	106,952	64,517	.....
Total private	1,208	28,742	7,439	7,213	4,450	10,410	**59,462**	625,008	342,726	4,515
November, 1936 (4 weeks)	**5,451**	**65,369**	**18,222**	**27,247**	**24,970**	**21,484**	**162,743**	.....	.....	10,793
October, 1936 (5 weeks)	13,665	73,997	31,715	35,920	37,849	26,996	**220,142**	.....	.....	8,092
November, 1935 (4 weeks)	9,534	51,212	23,131	17,205	29,639	24,252	**154,973**	.....	.....	2,294
Eleven months, 1936	131,387	705,085	273,513	359,306	391,828	259,425	.....	2,120,544	.....	89,962
Eleven months, 1935	86,245	390,816	189,887	240,069	251,563	196,065	.....	.....	1,354,645	80,589

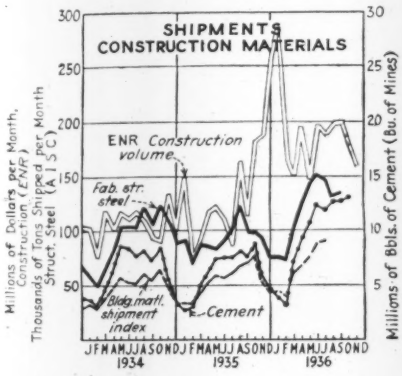


shipments in October gained 66.0 and 48.8 per cent over last year. Stocks at mills were 11.6 per cent lower than a year ago. The ratio of production to capacity is 56 for October and 56 for September compared with 33.1 for October, 1935.

Steel—The average operating rate of steel companies having 98 per cent of steel capacity of the industry who report to American Iron and Steel Institute is 74.3 for November compared with an average of 74.3 a month ago and 53.2 a year ago.

Effective December 1, steel prices are up from $2 to $4 per ton. Standard rails are increased from $36.375, which price has held since November 1933, to $39 per gross ton.

New business booked by the fabricated structural steel industry during October showed a further increase according to the American Institute of Steel Construction. Total new business for the first ten months of 1936 was 23 per cent larger than the total for twelve months of 1935. Shipments made during October were the


SHIPMENTS CONSTRUCTION MATERIALS
ENR Construction volume
Fab. str. steel
Bldg.matl. shipment index
Cement
Millions of Dollars per Month, Construction (ENR)
Thousands of Tons Shipped per Month Struct. Steel (A.I.S.C.)
Millions of Bbls. of Cement (Bu. of Mines)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1934 1935 1936

largest in volume of any month this year with the exception of June and July.

Lumber—Lumber production, reported to the National Lumber Manufacturers Association, averaged 62 per cent of the 1929 weekly average. Shipments averaged 62 per cent of the 1929 average.

Building Permits

According to the latest summary compiled by Dun & Bradstreet, Inc., the volume of building permits during October at 215 cities amounted to $90,686,556, compared with $88,696,190 in September, and $66,965,705 for October a year ago.

New York City fell behind the rest of the country last month, the total reaching only $16,282,663, against $17,331,441 during September and $21,474,945 in October, 1935. This represented decreases of 6.1 and 24.2 per cent, respectively.

Outside of New York (214 cities) building permits reached the sum of $74,403,893, the highest, with the exception of last July, since 1931. Comparison with the September figure of $71,364,749 showed an increase of 4.3 per cent, while contrast with the October, 1935, total of $45,490,760 revealed a rise of 63.6 per cent.

Labor

Gains of 2.4 per cent in employment and 4.9 per cent in pay rolls for October are shown by reports received from 9,687 contractors in the private building construction industry reporting to U. S. Bureau of Labor Statistics, Department of Labor. These contractors employed 122,200 workers in October who were engaged in the erection, altering, and repairing of private buildings. A comparison of employment in this industry in October 1936 with October 1935 shows an increase of 25.7 per cent over the year interval, while pay rolls over the same interval show a gain of 43.2 per cent. Employees engaged on projects financed by the Public Works Administration, Reconstruction Finance Corporation funds, or regular appropriations of the Federal, State, and local governments are not included in the private building construction totals.

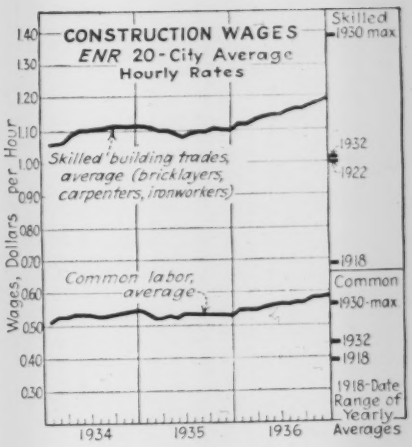
Employment on projects of the works program was 3,252,000 in October, an increase of 67,000 over the number employed in September. The increase occurred on that part of the program operated by the Works Progress Administration and was accounted for wholly by an expansion of employment in the drought areas. More than 2,646,000 of the total number engaged on the works program were employed on projects operated directly by the Works Progress Administration.

In October, approximately 300,000 workers were employed on construction projects financed by the Public Works Administration. Compared with the 323,000 employed in September, this was a decrease of 23,000 or 7 per cent in the number of wage earners.

Construction employment in New York State dropped 1.8 per cent from September to October. Pay rolls dropped 2.7 per cent and man-hours 3.2 per cent. The only general gain in employment, pay rolls and hours from September to October was reported by general building contractors. Highway and miscellaneous general contractors employed fewer workers and reduced pay rolls and hours. Sub-contractors employed a few more workers in October than September but reduced pay rolls and man-hours. These statements are based on the reports of more than 1,600 contractors reporting each month to the New York State Department of Labor's Division of Statistics and Information.

The Bureau of Labor Statistics, Department of Labor, has reported to the Public Works Administration that during September average wage hourly earnings reached the highest point since the program of the Public Works Administration was initiated in July, 1933. Reports from 48 state offices indicated that the average pay of PWA workers employed on both federal and non-federal programs during September was $.776 per hour according to their compilation. The lowest average wage during the course of the program was that of $.528 per hour in October, 1933. Hourly wage earnings over the three-year period average $.652.

Unskilled workers on the new sewage disposal plant in Denver, employed in two shifts of 5 hours each to get a 10-hour day went on strike October 27 for a 7-hour day. The controversy was settled October 29 by agreement on an 8-hour day. The wage rate, 62½ cents an hour, remains the same.



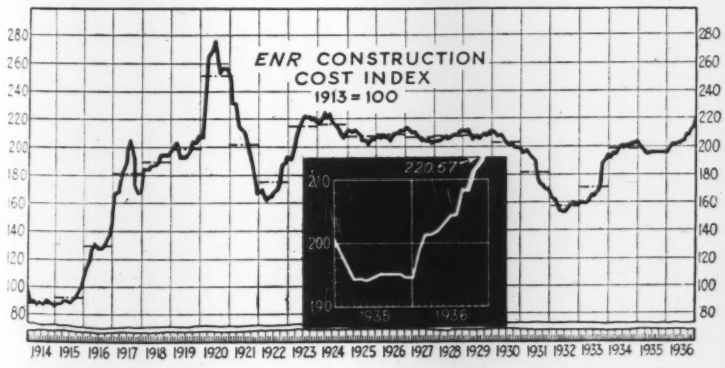
ENR Cost and Volume Index

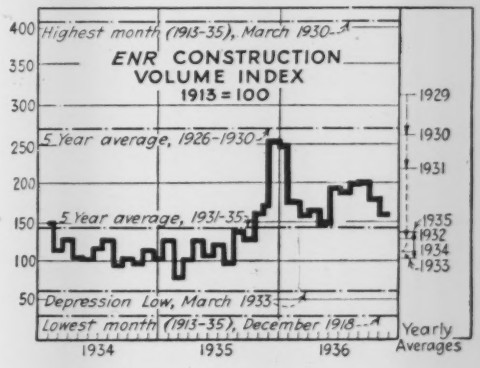
THE *Engineering News-Record* Construction Cost Index rises to 220.70, the highest value since May, 1924. This rise is due to increases in steel and lumber prices and further stiffening of labor wage rates.

The *ENR* Volume Index for November is 159.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Dec., 1936	**220.67**	**106.07**	**Nov., 1936**	**159**	**70**
Nov., 1936	212.70	101.67	Oct., 1936	178	78
Dec., 1935	194.90	93.69	Nov., 1935	171	75
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47





CURRENT PRICES OF CONSTRUCTION MATERIALS

CEMENT, AGGREGATES AND READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., carload lots, including 40c. per bbl. for bags, cash discount not included)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE (Ready-Mixed 1:2:4, 5000 lb. or more, delivered)
	Cloth Bags*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.83	$2.58	$2.50	$1.60	$1.60	$1.55	$1.69	$1.92	$1.69	$1.69	$8.50
Baltimore	2.66	2.41	2.21	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.80	1.80	7.35
Birmingham	2.40	2.15	1.95	1.80	1.80	1.45	1.00	1.00	.90	1.15	6.45
Boston	2.42	2.12	1.92	1.40	1.40	.90	1.40	1.40	.....	.....	6.50
Chicago	2.50	2.25	2.10	1.50	1.50	1.50	1.80	1.80	1.00	1.00	.....
Cincinnati	2.50	2.25	2.05	1.20	1.20	1.30	1.80	1.80	.....	.....	7.20
Cleveland	2.46	2.21	.....	1.40	1.40	1.45	1.60	1.60	1.75	1.75	7.85e
Dallas	2.45	2.20	2.00	1.55	1.55	1.30	1.95	2.05	.....	.....	7.00
Denver	3.09	2.84	.....	1.20	1.40	.90	.....	.....	.....	.....	.....
Detroit	2.25	2.00	1.80	1.30	1.30	1.20	1.50	1.75	1.40‡	1.50‡	7.95
Kansas City	2.51	2.26	2.06	1.85	1.85	1.15	1.85	1.80	.....	.....	7.65
Los Angeles	2.32	2.12	.....	1.20	1.20	.90	1.20	1.20	.....	.....	6.31
Minneapolis	2.80	.....	2.35	1.00p	1.00p	.25p	1.00p	1.00p	.....	.....	7.00f
Montreal	.....	.....	1.70	.80	.85	1.00	1.20‡	1.30‡p	.....	.....	6.50q
New Orleans	2.50	2.30	2.05	1.50	1.50	1.25	.....	.....	.....	.....	8.35
New York	2.70‡	2.45‡	.....	1.20†k	1.20†k	.70†k	1.75†k	1.85†k	.....	.....	8.00
Philadelphia	2.68	2.43	2.23	1.45‡	1.55‡	1.15‡	2.60‡	2.75‡	1.00‡	1.00‡	8.00D
Pittsburgh	2.46	2.21	1.61	1.50‡	1.50‡	1.70‡	2.25‡	2.25‡	1.50	1.50	7.00
St. Louis	2.53	2.28	.....	1.60‡	1.40‡1.25/1.40‡		.75p	.75p	.65/.95§	.50/.95§	6.95
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	.....	.....	7.53
Seattle	2.95	2.70	.....	1.00	1.00	1.00	1.44	1.44	.....	.....	6.75

*10c. allowed for each returnable bag. †Per cu. yd. ‡Delivered. §F.o.b. Granite City, Ill. kBarge lots alongside dock. pf.o.b. plant. q5 tons or more. rWithin 3-mi. from Pub Square. ston. d 5% discount for cash. D Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Alpena, Mich	$1.50	$1.45	Ironton, Ohio	$1.50	$1.45	North Birmingham, Ala	$1.75	$1.70
Buffington, Ind	1.70	1.65	Iola, Kans	1.70	1.65	Richard City, Tenn	1.85	1.80
Crestmore, Calif	1.72	.....	La Salle, Ill	1.70	1.65	Saginaw, Mich	1.40	1.35
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind	1.70	1.65	Steelton, Minn	1.80	1.75
Hannibal, Mo	1.70	1.65	Mason City, Ia	1.70	1.65	Universal, Pa	1.65	1.60
Hudson, N. Y	1.75	1.70	Norfolk, Va	1.76	1.71	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70
Independence, Kans	1.70	1.65	Northampton, Pa	1.65	1.60	Wyandotte, Mich	1.45	1.40

Cash Discounts, Cement, to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount, 10c. per bbl. for payment within 15 days of date of invoice.

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE—PARTITION—SCORED (Per M, lots of 2,000 pieces or over)			STRUCTURAL CLAY TILE—LOAD BEARING—SCORED (Per M, lots of 2,000 pieces or over)			BRICK (Per M, in quantity)		LIME (Per ton, in paper; carload lots)		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Hydrated finishing	Common hydrated	Pulverized or lump
Atlanta	$71.10	$75.80	$142.10	$170.50	$199.00	$227.40	$12.25	$14.25	$19.50	$14.00	$14.00
Baltimore	91.00	98.00	183.00	219.00	315.00	390.00	13.00	17.00	20.00	14.00	25.00
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	3.00§	1.75§	2.25s
Boston	79.90,t	85.20,t	159.75,t	181.05,t	237.30,t	271.20,	15.00	18.50	20.00	15.50	3.50d
Chicago	66.00	70.40	132.00	174.30	214.40	245.00	10.20	11.20	18.00	13.40	14.00
Cincinnati	58.85	62.80	117.75	141.30	169.26	209.56	17.50	17.50	15.97	12.48	.....
Cleveland	45.00	48.00	90.00	108.00	138.50	158.50	15.00	15.00	16.00k	14.00k	2.65kp
Dallas	68.00	67.00	140.00	160.00	190.00	260.00	13.50	24.00	19.00	16.00	1.55p
Denver	78.50	88.00	141.50	166.50	196.00	225.00	11.50	15.00	30.00k	22.00k	22.50k
Detroit	71.85	76.65	143.70	230.00	280.00	325.00	12.50	13.50	18.00	15.00	15.25
Kansas City	64.50	66.50	81.00*	125.50	159.75	186.25	13.00	22.00	18.90	12.40	10.35
Los Angeles	77.50	94.25	134.00*	188.00	232.50	311.50	11.50	14.00	18.70	.....	19.70
Minneapolis	80.15s	85.50s	145.40s	167.75s	175.25s	243.70s	13.10	15.10x	25.50	21.00	23.00
Montreal	84.00s	96.00s	180.00s	273.00	.....	.....	15.50	20.75	25.50	17.00	11.00
New Orleans	69.00	69.00	129.00	155.05	203.25	251.70	13.00	.....	18.40	11.25	.....
New York	78.40	83.60	125.40*	193.30†	238.80†	295.60†	12.50	.....	20.00	15.50	20.00
Philadelphia	86.00	90.00	150.00	200.00	240.00	280.00	18.00	20.00	16.35	11.25	10.75
Pittsburgh	58.40c	62.30c	116.85c	165.00c	217.00c	250.00c	16.50	25.00	17.20	14.50	2.22p
St. Louis	62.00	65.00	120.00	180.00	234.00	280.00	15.00	18.00	22.00	16.00	2.00q
San Francisco	84.00	94.50	225.00	.....	.....	.....	15.00	18.00	.55§	.40§	2.05s
Seattle	84.00	95.00	180.00	198.00	.....	.....	15.50d	18.50	30.00	20.00	28.60d

6x12x12 in. †F.o.b. Perth Amboy, N. J. ‡Per sack. §Per bbl., 200 lbs. pPer bbl. 180 lbs. qper bbl. 280-lb. kLCL. dless $1 cash 15 days. slump. sSmooth xSelected common. tCarload lots delivered to job.

ROAD SURFACING MATERIALS—F.O.B. CITY

	PAVING BRICK AND BLOCKS			PAVING ASPHALT (Per ton, less than 80 penetration)		ASPHALT BINDERS—FLUXES (Per gal., 80-300 penetration)		CUTBACK ASPHALT (Per ton)		ROAD OILS (Per gal.)		ASPHALT EMULSION (Per gal.)	
	Granite per M, lots of 50,000, 4x4x8 in.,	Brick per M, 3x4x8½ in., carload lots	Wood per sq. yd., 3½ in., 16-lb. treat,	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Drums
Atlanta	$ 75.00	$35.00	$2.25	$17.40z	$ 2.62z	$0.0687z	$0.100z	$18.15z	$26.20z	$0.687z	$0.0875	$0.0875	$0.0875
Baltimore	108.00	44.00	2.25	17.00	22.00	.075	.10	.09†	.125†	.....	.....	.....	.....
Birmingham	110.00	25.00	.....	19.00	24.00	.0878	.1128	.10†	.137†	.....	.06	.....	.....
Boston	75.00	46.00	2.80	17.00	22.00	.07e	.095e	.09†e	.12†e	.07e	.095e	.125e	.125e
Chicago	140.00	42.00	2.50	17.00	21.00	16.00	20.00	.07	.11	.045	.09	.135	.135
Cincinnati	115.00	37.00	.....	13.47	17.47	.12	.....	17.00	.....	.055	.08	.....	.....
Cleveland	100.00‡	32.50	2.85	17.50	21.20	.075	.094	.085	.055†	.0575	.085	.095	.095
Dallas	.....	30.00	.....	18.00	21.75	.065	.16	18.75	26.25	.055	.085	.11/.135	.11/.135
Detroit	.....	37.00	.....	16.80c	21.00c	.....	.....	15.25	20.25	.055	.11	.15	.15
Kansas City	.....	40.50	.....	18.50	23.50	17.50#	22.50#	.077†	.107†	.057	.11	.15	.15
Los Angeles	.....	50.00	.....	10.34	14.50	10.34#	14.50#	10.34	.....	.042	.06	.12	.12
Minneapolis	.....	.....	1.75i	18.20	24.70	.098	.098	21.85	34.65	.048	.....	.....	.....
Montreal	85.00	60.00	3.62	14.00	20.00	.10	.13	.0975†	.1175†	.0675	.135	.165	.165
New Orleans	100.00	32.00	.....	15.20	18.75	.068	.095	.075†	.10†	.....	.0785	.11	.11
New York	120.00§	65.00	2.75	17.00	22.00	.075	.10	.09†	.125†	.....	.075	.11	.11
Philadelphia	110.00	45.00	2.25	13.50	18.00	.05	.08	.05†	.08†	.045	.08	.....	.....
Pittsburgh	115.00	40.00	.....	19.00	24.00	.077	.1125	.086†	.121†	.0675	.....	.....	.....
St. Louis	115/120	35.00	.....	19.20	24.20	.077	.107	.082 †	.112 †	.045	.09	.125	.125
San Francisco	.....	50.00	.....	12.00	18.00	12.00#	18.00#	12.50#	23.00#	.04	.0575	.117	.117
Seattle	.....	35.00	.....	25.50	25.50	17.00#	23.00#	15.00	.....	.03	.19	.20	.20

Note: Paving asphalt, tank car or boat, f.o.b. Maurer, N. J., per ton, Bermudes, $25.00; Trinidad, $21.00. *Per sq. yd. †Per gallon. ‡4½x6x5½ in. §per ton ¶4x5x9-in. Av. #Mexican. zLocal reduction due to 20% reduction intra-state class freight rates, only Georgia affected l 2½ in. 6 to 8-lb. treatment. e F.o.b. Everett

CURRENT PRICES OF CONSTRUCTION MATERIALS

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet,	RIVETS ½-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton			TRACK SUPPLIES			
						Standard	Light	Re-rolled	Angle bars	Std. spikes	Tie plates	Track bolts
Birmingham	$2.20	$2.10	$3.15	$2.55	.....	$39.00	$35.00	$34.00	$2.70	$2.75	$2.125	$3.75
Chicago	1.95	2.10	3.15	2.15	$2.35	39.00	35.00	34.00	2.70	2.75	2.125	3.75
Pittsburgh	2.075	2.05	3.05	2.05	2.25	39.00	35.00	34.00	2.70	2.75	2.125	3.75

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

F.O.B. WAREHOUSE	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price		EXPANDED METAL LATH —Per 100 sq.yd., carload lots—		WELDED FABRIC REINFORCING —Per 100 s.f., carload lots—			SHEET PILING Per 100 lb. base price
		New billet	Rail steel	Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq.yd.	
Atlanta	$3.36	$2.34	$2.19	$21.00	$23.00	$1.58	$1.20	$0.1494	$2.70
Baltimore	3.25	3.00	2.85	26.00	28.00	1.45	1.11	.1368	2.70
Boston	3.64	2.823	1.962	22.00†	24.00†	1.51	1.15	.1422	2.57
Chicago	3.30	2.10	1.95	20.00	22.00	1.44	1.11	.1359	2.35
Cincinnati	3.52	3.25	3.25	25.01	29.50	1.43	1.10	.1350	.....
Cleveland	3.31	2.75	2.60	20.00	22.00	1.42	1.09	.1332	.....
Dallas	3.45z	2.825z	2.675z	22.00	28.00	1.69	1.27	.1593	3.005
Denver	4.05	3.76	3.61	22.00	25.00	1.70	1.27	.1611	.....
Detroit	3.52	2.20	2.05	20.00†	22.00†	1.45	1.11	.1368	2.53
Kansas City	3.85	2.75	2.60	19.00	21.00	1.55	1.18	.1467	2.79
Los Angeles	2.35	2.475	.....	23.00	27.50	1.72	1.29	.1629	2.65
Minneapolis	3.55	2.86	2.71	22.00	26.00	1.54	1.17	.1458	2.67§
Montreal	3.25	2.15	2.15	32.50	35.50	2.46	1.82	.253	2.30
New Orleans	.....	.....	.....	20.75	23.75	1.59	1.20	.1503	.....
New York	3.47	2.50	2.35	17.50	20.50	1.48	1.13	.1395	2.60
Philadelphia	3.10	3.06	2.22	20.00	24.00	1.46	1.12	.1377	2.56
Pittsburgh	1.90‡	1.85‡	1.90‡	20.00‡	22.00‡	1.38	1.07	.1296	2.425
St. Louis	3.55	2.45	2.30	22.00	25.00	1.45	1.11	.1368	2.30
San Francisco	3.50	2.475	2.325	24.50	26.50	1.72	1.29	.1629	3.00
Seattle	3.55	2.50	.....	24.50	26.50	1.72	1.29	.1629	2.60

‡Base Mill Price. Note: Shapes, bars and piling subject to quantity discounts. §Mill Price plus freight to Minneapolis. †f.o.b. delivered. zf.o.b. Houston

PAINTING AND ROOFING SUPPLIES—F.O.B.

	RED LEAD Per 100 lb. in 500-lb. lots	WHITE LEAD Per 100 lb. in 500-lb. lots#	READY-MIXED PAINT Per gal., drums			ROOFING SUPPLIES Carload lots, f.o.b. factory				
	Dry	in oil	Graphite*	Aluminum†	Ferric Oxide‡	Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating, per gal.	Tar pitch, 350 lb. bbl., per ton
Atlanta	$7.75	$11.00	$1.60	$2.50	$1.40	$1.94	$1.70	$1.70	$.36	$25.60
Baltimore	7.00	10.50	1.45	2.25	1.70	2.03	3.00	3.00	.35	25.00
Birmingham	7.25	11.00	2.35	2.35	1.85	2.01	1.77	1.77	.36	22.00
Boston	7.00	10.50	1.85	2.65	.0475x	1.75	3.10	3.10	.42	20.00
Chicago	7.00	10.50	1.35	.....	.....	2.35	2.16	2.16	.34	33.00
Cincinnati	7.00	10.50	1.45	2.50	1.40	2.40	2.39x	2.39x	.36	21.00
Cleveland	7.00	10.50	1.70	2.45	1.40	1.55	1.75x	1.75x	.23	19.00
Dallas	7.25	11.50	1.80	2.10	.....	2.35x	3.80	3.80	.14	35.00
Denver	7.50	11.25	2.55	.....	.....	2.25	3.55	3.55	.35	30.00
Detroit	7.00	10.50	1.65	2.30	1.40	2.50	2.65	2.50	.35	30.00
Kansas City	7.00	10.62½	1.65	2.65	1.10	1.82	3.15	3.15	.25	24.50
Los Angeles	7.25	10.75	1.60	2.25	2.30	2.00	1.50	.....	.45	.....
Minneapolis	7.00	10.62½	.....	.....	.....	1.75v	1.62Av	1.62Av	.29	23.80
Montreal	.....	8.20	2.00	4.75	2.40	2.50	1.60	1.83	.50	1.52§
New York	7.00	10.50	1.75	2.35	1.50	1.75	1.62x	1.62x	.232	22.00
Philadelphia	7.00	10.50	2.50	2.95	1.50	1.68	1.86x	1.48x	.37	22.00
Pittsburgh	7.00	10.50	1.05	1.95	.80	1.84	1.65x	1.65	.34	24.00
St. Louis	10.00	10.50	1.85	2.45	1.50	1.83x	2.57	2.57	.25	25.00
San Francisco	7.25	10.75	1.80	2.75	1.10–2.00	1.54	1.90	1.90	.325	22.00
Seattle	7.25	10.75	1.80	2.85	2.20	1.97	2.44	2.60	.60	30.00

*U. S. War Dept. Spec. 3-49A. †ASTM Spec. D266-31. ‡80% maximum ferric oxide. §Per 100 lb. xPer roll, 65 lb. xPer lb. v Minneapolis & vicinity
Note: Red lead in oil 50c higher than white lead in oil. #Basis of quoting changed this month from list to 500-lb. lots.

MISCELLANEOUS ITEMS

WINDOW GLASS

Discounts from latest jobbers List, Sept. 15, 1928

	Single or Double Thickness A quality	B quality
Atlanta	80%	80%
Baltimore	88%	90%
Birmingham	88%	90%
Boston	88–10–5%	90–10–5%
Chicago	86%	87%
Cincinnati	89–10%	91–10%
Cleveland	85%	85%
Dallas	87%	89%
Denver	88%	90%
Detroit	87–10%	89–10%
Kansas City	85–10%	86–10%
Los Angeles	90%*	90–40%
Minneapolis	84%	85%
Montreal	60–30%	70–5%
New Orleans	88%	90%
New York	86%	87%
Philadelphia	89%	90%
Pittsburgh	88%	88%
St. Louis	89%	89%
San Francisco	80%	85%
Seattle	90–10%	90–20%

*Disc. from list Aug. 1, 1929. †F.o.b. Arsenal. ‡Double thickness A & B.
xManhattan only – other Boroughs $6 per trip. o carload lots

EXPLOSIVES

Per lb. dynamite delivered 50-lb. cases

	Gelatin 40%	60%
Atlanta	$0.135	$0.15
Baltimore	.145	.16
Birmingham	.095	.11
Boston	.13	.145
Chicago	.105o	.12o
Cincinnati	.27	.29
Cleveland	.215	.225
Dallas	.1350	.1500
Denver	.145	.16
Detroit	.21	.24
Kansas City	.15	.165
Los Angeles	.1725†	.1925†
Minneapolis	.145	.16
Montreal	.18	.1925
New Orleans	.215	.23
New York	.215x	.23x
Philadelphia	.13	.1450
Pittsburgh	.10	.115
St. Louis	.13	.145
San Francisco	.1475	.1625
Seattle	.1425	.1575

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York.

Bleaching powder, in drums, F.o.b. works, per 100-lb	$2.00–2.85
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	22.00–35.00
Chlorine cylinders, per lb. delivered	.055
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.35
Soda ash, 58%, in paper bags, per 100 lb. dense	1.25
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	27.00–30.00
Sulphate of copper, in bbl., per 100-lb	4.15

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf—Barge	Short Leaf—Rail	Long Leaf—Barge	Long Leaf—Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.16	$0.195	$0.16	$0.19
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.20	.24	.18	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21	.255	.19	.24½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.23	.265	.23½	.27½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.25	.275	.27½	.33½
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.35	.415	.....	.....
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.37	.482	.....	.....

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In by 8½ Ft.
Boston	Oak, untreated	$1.00	$1.40
	Pine, untreated	1.10	1.45
	Pine, creosoted	1.55	2.10
New York	Long-leaf sap pine, untreated	1.05	1.25
	Mixed oak, untreated	1.20	1.40
	White oak, untreated	.85	1.35
Birmingham	Red oak, creosoted	1.50	1.70
	Southern pine, untreated *6x8x8'6"	.55*	.70
	Southern pine, creosoted	1.10*	1.30
Chicago	White oak, untreated	1.15	1.40
	Oak, empty cell, creosoted	1.50	1.88
	Oak, zinc treated	1.40	1.70
	Southern pine, creosoted	1.35	1.78
Los Angeles	Fir, untreated	.50	.72
	Fir, creosoted	1.67	2.40
Philadelphia	Red oak, untreated	1.00	.....
	Red oak, creosoted	.....	2.10
St. Louis	White oak, untreated	1.05	1.45
	Red oak, untreated	1.02	1.40
	Red oak, creosoted	1.55	1.95
	Sap Pine or cypress, untreated	.87	1.20
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	.65	.75
	Birch or maple, creosoted	1.05	1.35

CURRENT PRICES OF CONSTRUCTION MATERIALS

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE	VITRIFIED SEWER PIPE				CLAY DRAIN TILE		CONCRETE SEWER PIPE		WROUGHT STEEL PIPE — Full standard weight. #			
	Per net ton, f.o.b. 6 in. to 24 in.*	Per foot, delivered, ASTM C 13-35 8 in., s.s.	12 in., s.s.	24 in., d.s.	36 in., d.s.	Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	Per ft., delivered; ASTM C 14-35 12 in.	24 in.	‡ to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$43.00	$0.25dl	$0.45dl	$1.625l	$4.50l	$85.00	$128.00	$0.45	$1.625	49.5	40.5	47	37.5
Baltimore	46.50	.28	.54	2.38	7.18	110.00	170.00	.40	1.60	....	....	....	....
Birmingham	39.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	69.5	61.5	67	58.5
Boston	46.50	.224	.432	1.98	5.845	99.00	153.00	.42	2.35	....	....	....	....
Chicago	47.50	.245	.4725	2.025	4.60	60.00	120.00	.36	1.42	58.75	48.75	55.625	45
Cincinnati	46.00	.189	.3645	1.62	5.535	69.00	108.00	.40	1.40	58.75	48.75	55.625	45.00
Cleveland	47.50	.168	.324	1.44	4.1225	42.50	88.50	.32	1.64	61	51	57.9	47.25
Dallas	51.00	.35	.67	2.70	.....	165.00	260.00	.46	1.57	69.5	61.5	67	58.5
Denver	59.00	.27‡	.47‡	1.98‡	.....	105.00	180.00	.....	.....	50	40	47	36
Detroit	47.50	.203	.3915	1.71	5.2375	82.00	136.00	.35	1.20	59.3	49.3	56.1	46.5
Kansas City	49.00	.30	.54	2.16	5.00	120.00	140.00	.40	1.50	55	45	51.5	41
Los Angeles	47.50	.2825‡	.508‡	2.03‡	5.535‡	115.50	192.50	1.00	2.80	62.1	54.1	59.6	51.1
Minneapolis	49.50	.24‡	.432‡	1.728‡	4.60‡	.....	.....	.65	1.75	....	....	....	....
Montreal	50.00	.33‡	.59‡	2.04‡	.....	82.00	134.00	.51	2.04	....	....	....	....
New Orleans	45.00	.23	.41	1.60	.....	67.00	.....	.47	1.67	....	....	....	....
New York	46.00	.24	.49	2.20	6.10	.....	.....	.55	2.00	57.50*	47.50*	54.375*	43.75*
Philadelphia	43.00	.336	.648	2.835	8.68	175.00	210.00	.54	1.80	52.37*	41.35*	53.39*	42.37*
Pittsburgh	49.00	.168‡	.324‡	1.35‡	4.92‡	52.00	81.00	.75c	1.75	69.5	61.5	67	58.5
St. Louis	46.00	.25	.45	1.83	3.96	85.00	170.00	1.00	2.25	57.125	47.125	54	43.375
San Francisco	47.00	.29L	.522L	2.088L	5.67L	103.50	172.50	.45	2.20	56.37	47	50	39
Seattle	48.50	.4225	.63†	3.06†	7.55†	85.00	200.00†	.50†	1.80	65.80	57.25	66.75	56.30

*b & s class B and heavier, C/L lots, 200 tons and over. Burlington, N. J. (base) $43.00. Gas pipe and class A, $3 per ton additional. 4-in., $3 per ton additional. 30 in. and larger usually $2 per ton less

#Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¼ in., 8½c; ⅜ in. 11½c.; ½ in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92.

‡2½ to 3 in. *Resale price to consumer, car load lots shipped from mill.

‡f.o.b. †Less 30% in C/L Lots. c Concrete Culvert pipe reinforced. dDouble strength. lList to dealers. L list. tSales & municipal taxes extra.

LUMBER AND TIMBER—PER M FT. B.M., CARLOAD LOTS F.O.B.

		SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft.								LONG LEAF Y. P. Merchantable grade up to 20 ft.	
		1x6,#	1x8,#	2x4,#	2x6,#	2x8,#	2x10,#	3x12,R	6x12,R	12x12,R	2x12,R	12x12,R
Atlanta	Southern Pine	$18.50	$18.50	$18.50	$20.50	$20.50	$21.00	$26.00	.....	.....	$40.50	$40.50
Baltimore	Southern Pine	23.50	24.50	27.50	26.50	27.00	29.00	37.50	.....	.....	55.00	57.00
	Douglas Fir	29.50	29.50	28.50	29.50	28.50	28.50	30.50	$29.00	$29.00	.....	.....
Birmingham	Southern Pine	22.00	22.00	22.00	21.00	22.00	26.00	30.00	30.00	29.00		
	Long Leaf	23.00	23.00	26.00	25.00	26.00	32.00	45.00	.....	.....	48.00	48.00
Boston	Poofers N.C. Pine	29.00	29.00	31.00†	33.00†	49.00†	55.00†	73.00†	.....	.....	73.00	73.00
	Douglas Fir	27.00	27.00	29.00	33.00	35.00	35.00	35.00	35.00	35.00		
Chicago	Southern Pine	29.00	30.00	28.00	27.00	28.00	31.00	45.50	.....	.....	54.50	54.50
Cincinnati	Southern Pine	25.50	25.50	25.50	24.50	25.50	28.50	39.50	.....	.....	41.00	44.00
	Douglas Fir							43.75	43.75	43.75		
Cleveland	Southern Pine	30.00	32.00	38.00	32.00	36.00	38.00	49.00	44.00/	46.00/	52.00	64.00§
Dallas	Southern Pine	d33.75	35.10	38.25	36.00	36.90	38.25	50.85	65.25	59.85	66.29	68.05
Denver	Douglas Fir	42.00	42.00*=	43.00*	43.00*	43.00*	47.00*	52.00*	56.00*	61.50	.....	.....
Detroit	Southern Pine	26.50	26.50	26.50	26.50	26.50	30.50	38.00	.....	.....	32.00	44.00
	Douglas Fir							42.50	42.50	43.00		
Kansas City	Southern Pine	25.50	26.00	26.50	22.50	26.50	27.00	35.00	.....	.....	50.00	60.00
	Douglas Fir	27.00	28.00	29.00	28.00	29.00	29.00	33.00	36.00	36.00	.....	.....
Los Angeles	Douglas Fir	32.00,	32.00,	32.00,	32.00,	34.00,	34.00,	36.00,	45.00y	40.00y	.....	.....
Minneapolis.c	Western Pine	45.00*	51.50*	50.00*	41.00*	41.00*	42.00*				58.00*b	.....
	Douglas Fir	42.00*	42.00*	43.00*	43.00*	43.00*	43.00*	55.00*	59.50*	59.50*	54.00	.....
Montreal	Pine	45.00	45.00	49.00	47.00	48.00	58.00					
	Douglas Fir	39.50	39.50	40.00	40.00	40.00	41.50	42.00	42.00	42.00	82.00	76.00
New Orleans	Southern Pine	23.50	25.50	28.00	25.00	27.00	25.50	38.00	.....	.....	44.00	54.00
	Douglas Fir	28.50	30.00	33.00	29.00	32.00	33.50	37.00	.....	.....	.....	.....
New York	Southern Pine	35.00*	36.00*	34.00*	36.00*	36.00*	37.00*	45.00*	.....	.....	77.50*	77.50*
	Douglas Fir	.....	.....	40.00*	40.00*	41.00*	41.00*	42.50*	45.00*	45.00*	.....	.....
Philadelphia	Southern Pine	30.00	31.00	32.00	32.00	33.00	34.00	36.00	.....	.....	36.00	42.00
	Douglas Fir	45.00	45.00	45.00	45.00	45.00	45.00	45.00	42.00	42.00	.....	.....
Pittsburgh	Southern Pine	30.50	31.90	37.65	33.75	36.52	37.50	47.75	.....	.....	57.50	57.50
	Douglas Fir	41.52	39.70	39.70	38.55	39.10	39.38	53.25	53.25	53.25	.....	.....
St. Louis	Southern Pine	29.50*x	30.50*x	29.00*x	28.00*x	29.00*x	30.00*x	46.00*x				
	Douglas Fir								54.00*x	54.00*x	71.00	70.00
San Francisco	Douglas Fir	20.50'	20.50'	21.00'	21.00'	21.50'	22.50'	22.00'	22.00'	22.00'	.....	.....
Seattle	Douglas Fir	15.50	15.50	15.50	14.50	14.50	14.50	21.00	20.00	20.00	.....	.....

*Delivered. †Spruce. ‡Long-leafed Y. P. §Norway Pine. ▲Northern Pine. =Native. tAt ship's tackle. ,Yard prices. 'Rgh. *Contractors in Minneapolis and St. Paul get 15% disc. from list. f Douglas Fir. #S4S. 10% Disc. taken off. x5M ft. or less

CURRENT BUILDING AND CONSTRUCTION WAGE RATES PER HOUR

	Bricklayers	Carpenters	Structural Iron Workers	Hoisting Engineers	Plasterers	Common Labor — Building	Common Labor — Heavy Const.
Atlanta	$1.125	$0.40/1.00	$1.25	$1.00/1.50	$1.00	$0.30/.40	$0.30/.40
Baltimore	1.25	1.10	1.37½	1.25	1.25	.45	.45
Birmingham	1.00	1.00	1.25	1.125	1.00	.30/.40†	.30/.40†
Boston	1.30	.70/1.175	1.20	.90/1.425	1.375	.50/.625	.50/.70
Cincinnati	.80/1.375	.65/1.20	1.25	1.00/1.25	.80/1.375	.45	.45
Chicago	1.50	1.50	1.50	1.50	1.50	.95	.95
Cleveland	1.375	1.25	1.25	1.25	1.50	.82	.82
Dallas	.65/1.00	.65/1.00	.65/1.00	.65/1.00	.65/1.00	.35/.50	.35/.50
Denver	1.25	1.25	1.25	.....	.....	.625	.625
Detroit	1.25	1.00	1.25	1.25	1.25	.50/.75	.60
Kansas City	1.325	1.25	1.25	1.25	1.425	.80	.45/.50
Los Angeles	1.10	1.10	1.125	1.125	1.25	.60	.60
Minneapolis	1.25	1.10	1.25	1.25	1.35	.75	.75
New Orleans	1.00	.75	1.00	1.00	1.25	.30/.40	.30/.40
New York	1.50	1.40	1.65	1.50/1.5625	1.50	.82½	.50/.80
Philadelphia	.35/1.50	.65/1.10	.70/1.375	.90/1.00	1.10/1.37	.35/50	.40/.50
Pittsburgh	1.50	1.25	1.375	1.00	1.50	.70	.50
St. Louis	1.50	1.25	1.47	1.57/1.75	1.50	.78½	.35/.78½
San Francisco	1.50	1.125	1.37½	1.12½	1.50	.875	.60
Seattle	1.00	1.00	1.25	1.25	1.25	.60	.60
Monteral	.70	.60	.80	.55	.70	.35	.40

Skilled Avg.: (Bricklayers, Carpenters, Ironworkers) $1.180 Common Avg. $0.586 † PWA.